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GROUP EVALUATION OF THE ACCURACY OF A  
SET OF TIME STANDARDS

A Thesis

Submitted to the Faculty

of

Purdue University

by

Joseph Hammond Earnest, Jr.

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science in Industrial Engineering

June, 1950

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The author is very grateful to all who have helped make this work possible, and wishes to express his sincere thanks to:

Dr. Marvin E. Mundel for his valuable guidance and help;

The Motion and Time Study Department Staff for their cooperation and generosity in the use of their equipment;

The Computing Laboratory for their valuable assistance in sorting the data;

My wife for assistance in processing the data;

The Work Session Personnel for their assistance and cooperation.

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The Computing Laboratory for their valuable assistance in carrying the

data

My wife for assistance in processing the data

The York Section Personnel for their assistance and cooperation.



In the field of time study perhaps the most difficult problem is the rating or relating of the performance to standard. Misunderstandings caused by inconsistent or inaccurate rating of performance can and do cause labor disturbances such as grievances or even strikes.

The problem of this thesis was to evaluate and compare the time study ratings of X Company<sup>1</sup> and the ratings of the other engineers in regard to any differences, if such exist, that might be caused by different concepts, different methods of rating, different geographical areas, different types of companies and types of work with which the time study men are familiar, differences in experience, differences in training, differences in the size of the town or differences in size of the company. Particular attention was given to the consistency of ratings used by X Company as evaluated by the experimental group.

To accomplish these objectives the films furnished by X Company were rated by time study engineers at the Fifth Annual Motion and Time Study Work Session by three methods:

1. A system similar to that used by Company X; viz., judgment of the raters for both a reasonable concept to compare to and a numerical appraisal in reference to this concept.
2. Single-image motion picture as standard or bench mark.
3. Multi-image motion picture with 12 different poses of the same job as a graduated bench mark.

1 X Company is the name assigned to conceal correct name of the concern actually involved.

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rating or relating of the performance to standard. Misunderstandings  
arise by inconsistent or inadequate rating of performance and do  
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2. Single-image motion picture as standard or bench mark.
3. Multi-image motion picture with 15 different scenes of the same job  
as a standard bench mark.

Company is the name assigned to company correct name of the company  
actually involved.

The data were classified by means of the questionnaires, and International Business Machine Equipment was used to sort and to tabulate the various subgroups.

After the ratings were brought to the same base and allowances were applied where required, comparisons of X Company and work session ratings were made by comparison graphs and least square lines to determine any differences, if such existed. To determine if such results could possibly have occurred by chance alone, or were statistically significant, "t" tests were made upon the above.

The following conclusions were made:

1. In the comparison of the best approximation of 100 by the work session using the judgment technique with X Company's concept of standard, the company averaged 17.3 per cent higher on the six jobs. Statistical "t" tests indicate that this difference is significant at the 5 per cent level. In other words, this difference could occur by chance only one time in twenty. In addition, Elia<sup>2</sup> found that 33 per cent of the work session engineers rated within  $\pm 5$  per cent, 43.4 within  $\pm 7.5$ , 58.3 within  $\pm 10$  and 84.6 per cent within  $\pm 20$  per cent of the overall means to which the X Company ratings were compared above.
2. In the comparison of the best approximation of 100 by the work session using the single-image bench mark with X Company's concept of standard, the company averaged 10.7 per cent higher on

2 Elia, A. J., An Analysis of Current Practice Time Study Ratings, Thesis Purdue University, 1950.

These data were brought to the attention of the American Society of Mechanical Engineers.

Applied to the work of the American Society of Mechanical Engineers, the results of the

analysis were as follows: comparison graphs and least squares lines to deter-

mine any differences, if such existed. To determine if such results

could possibly have occurred by chance alone, or were statistically sig-

nificant, the tests were made upon the above.

The following conclusions were made:

1. In the comparison of the work of the American Society of Mechanical Engineers

with the work of the American Society of Mechanical Engineers, the results of the

analysis showed that the work of the American Society of Mechanical Engineers

was statistically different from the work of the American Society of Mechanical Engineers

at the 5 per cent level. In other words, this

difference could occur by chance only one time in twenty. In

addition, the results showed that 55 per cent of the work of the American Society of Mechanical Engineers

was within  $\pm 5$  per cent, 32.4 within  $\pm 7.5$ , 25.2 within  $\pm 10$  and

84.6 per cent within  $\pm 20$  per cent of the overall mean to which

the American Society of Mechanical Engineers were compared above.

2. In the comparison of the work of the American Society of Mechanical Engineers

with the work of the American Society of Mechanical Engineers, the results of the

analysis showed that the work of the American Society of Mechanical Engineers

was statistically different from the work of the American Society of Mechanical Engineers

at the 5 per cent level. In other words, this

the six jobs. In the statistical "t" test, "t" was 0.61 which means that there was probably no statistically significant difference between the two concepts of standard. Sherwood<sup>3</sup> found that 33 per cent of the work session engineers rated within  $\pm 5$  per cent, 48 per cent within  $\pm 7\frac{1}{2}$  per cent, 58 within  $\pm 10$  and 89 within  $\pm 20$  of the overall means to which the X Company ratings were compared above.

3. There was no appreciable difference in the concepts of standards between the work session, using the Mundel<sup>4</sup> method of rating and the multi-image bench mark, and the X Company. In the comparison of the best approximation of 100 by the work session and the company, the latter averaged 0.17 per cent lower on the six jobs. However, job number three was 27 per cent higher than the work session mean rating. Greenberger<sup>5</sup> found that 36 per cent of the work session engineers rated within  $\pm 5$  per cent, 47 within  $\pm 7\frac{1}{2}$ , 62 within  $\pm 10$ , and 90 within  $\pm 20$  per cent of the overall means to which the X Company ratings were compared above.

3 Sherwood, R. G., An Evaluation of a Single Standard, Single Image Rating Aid for Time Study Rating, Thesis, Purdue University, 1950.

4 Mundel, M. S., Ph. D. Systematic Motion and Time Study, New York, Prentice-Hall Inc., 1947.

5 Greenburger, F. R., An Evaluation of the Mundel Multi-Image Rating Loop, Thesis, Purdue University, 1950.

There was no appreciable difference in the concept of standards between the work session and the model method of rating and the multi-image bench mark, and the X Company. In the comparison of the best approximation of 100 by the work session and the company, the latter averaged 0.17 per cent lower on the six jobs. However, the number three was 27 per cent higher than the work session mean rating. Greenberger found that 20 per cent of the work session engineers rated within  $\pm 5$  per cent, 47 within  $\pm 10$ , 20 within  $\pm 15$ , and 20 within  $\pm 20$  per cent of the overall mean to which the X Company ratings were compared above.

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1. Greenberger, E. H. "An Evaluation of the Model Multi-Image Rating Method." *Theoretical Psychology*, 1970.
2. Greenberger, E. H. "An Evaluation of the Model Multi-Image Rating Method." *Theoretical Psychology*, 1970.
3. Greenberger, E. H. "An Evaluation of the Model Multi-Image Rating Method." *Theoretical Psychology*, 1970.
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1	Number of employees being trained	10
2	Number of employees being trained	20
3	Number of employees being trained	30
4	Number of employees being trained	40
5	Number of employees being trained	50
6	Number of employees being trained	60
7	Number of employees being trained	70
8	Number of employees being trained	80
9	Number of employees being trained	90
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## INTRODUCTION

In the field of time study perhaps the most difficult problem is the rating or relating of the performance to the standard. Misunderstandings caused by inconsistent or inaccurate rating of performance can and do cause labor disturbances such as grievances or even strikes. Gomberg, head of the industrial management department of the International Ladies Garment Workers' Union, states that "all claims by engineers for their pet procedures rest upon an assumed validity of existing time study practices well within the percentage increment or decrement to the wage scale involved in collective bargaining negotiation. Obviously, if after months of negotiations and possible strikes at great financial sacrifice to both sides, a settlement has been reached involving a ten per cent change in the basic rates, neither management nor labor is prepared to sacrifice its respective rights to the blind operations of a technique of questionable accuracy.

"The use of a time study technique to set production standards whose demonstrated inaccuracy may exceed this percentage can become the source of much controversy."<sup>1</sup>

There are many methods proposed for rating the performance of a worker. At the Fifth Annual Time Study Work Session, three methods were used. They were judgment, single-image standard film, and multi-image calibrated film. The first, judgment, consisted of the engineers using

1 Gomberg, W., A Trade Union Analysis of Time Study, Science Research Associates, Chicago, 1948, p. 14.

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There are many methods proposed for rating the performance of a worker.  
 At the 1911 Annual Time Study Convention, three methods were used.  
 They were judgment, single-image standard film, and multi-image stan-  
 dard film. The first, judgment, consisted of the engineers using

whatever method they normally used. The procedure, however, was, to a large extent, based upon the engineers' experience and ability to estimate the worker's performance and compare it to whatever concept of standard performance the engineers might have.

This method places two tasks upon the engineer. He must develop a mental concept of standard performance and then compare the employee's performance to this standard. Different concepts of standard performance between engineers of a particular company or between companies cause inconsistencies in ratings of the same performance under the same conditions. When the conditions change, the ratings should change. How much? The problem is to evaluate this difference. Here is another place for inaccuracy and inconsistency. From the above we see that the use of "judgment" technique for the time study rating might permit the occurrence of inconsistencies as a result of individual differences. Tiffin<sup>2</sup> states that in human endeavor individual differences exist as a normal distribution which approximates a bell-shaped curve, with most raters being near average and few being very high or very low.

In an attempt to find a solution for the above problem, Dr. M. E. Mundel<sup>3</sup> proposed a technique of rating in which a physical representation of the standard is used; for example, a film of an industrial job. The single-image rating aid consists of a single loop of film of a laboratory job which was used as the standard for rating of the pace

2 Tiffin, J., Ph. D. Industrial Psychology, New York, Prentice-Hall Inc., 1947, p. 17.

3 Mundel, M. E., Ph. D. Systematic Motion and Time Study, New York, Prentice-Hall Inc., 1947, p. 159.

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This method places two checks upon the engineer. He must develop a mental concept of standard performance and then compare the employee's performance to this standard. Different concepts of standard performance between engineers of a particular company or between companies cause inconsistencies in ratings of the same performance under the same conditions. When the conditions change, the ratings should change. Now what? The problem is to evaluate this difference. Here is another place for inconsistency and inconsistency. From the above we see that the use of "judgment" technique for the time study rating might permit the occurrence of inconsistency as a result of individual differences. Rating studies show in human endeavor individual differences exist as a normal distribution which approximates a bell-shaped curve, with most ratings being near average and few being very high or very low.

In an attempt to find a solution for the above problem, Dr. M. E. Mendenhall proposed a technique of rating in which a physical representation of the standard is used; for example, a film of an industrial job.

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5 TITM, J. L. M. D. Industrial Engineering, New York, McGraw-Hill Inc., 1947, p. 17.  
 5 Mendenhall, M. E., Psychometric Rating and Time Study, New York, McGraw-Hill Inc., 1947, p. 129.



alone of the other jobs at the work session. Note, there is a fundamental difference. Under the 'judgment' method the entire performance is evaluated against a judged concept, while under the Mundel system, only the pace is rated against an objective standard. Under the latter method, the three factors present are still acknowledged as determining the relative worth of the performance; they are skill, aptitude, and physical exertion. However, Mundel states that skill and aptitude both enter into pace, and physical exertion depends on pace and job difficulty. Only these last two factors are really appraisable. Job difficulty may be reduced to observable measurements which may be obtained from an allowance table leaving only pace to be evaluated.<sup>4</sup> It is believed that the use of this film as a bench mark, or standard, will increase the accuracy and consistency of the ratings.

In addition, the multi-image film with twelve different paces of the same job was proposed as a graduated bench mark by Mundel for determining the rating of any job in order to eliminate, if possible, the tendency of time study engineers to rate all jobs alike: the slow, too high and the fast, too low.

As will be mentioned in detail in the procedure, X Company uses the "judgment" technique. In order to evaluate the ratings of the X Company, it was proposed to rate the films of their industrial jobs by the three techniques: "judgment", single-image and multi-image films.

<sup>4</sup> Ibid, p. 163.



and III

The problem is to evaluate and compare the time study ratings of A Company and the ratings of the other engineers in regard to any differences, if such exist, that might be caused by basic inconsistencies, different methods of rating, different geographical areas, different types of companies and types of work with which the time study men are familiar, differences in experience, differences in training, differences in the size of the town, or differences in the size of the company.

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familiar, differences in experience, differences in training, differences

in the size of the town, or differences in the size of the company.

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Motion pictures of the industrial jobs were furnished by X Company. They consisted of films which X Company considered standard for each of the six jobs and other films from which short loops of each of the jobs at a faster and slower pace could be obtained.

The films were:			Name of Job
Job #1	Film #		
	1.	slower	
	2.	standard	evap. liq. inlet hand form 2nd & 3rd
	3.	faster	bend OPN #12
2	4.	slower	
	5.	standard	assembly of thermo body, drive shaft,
	6.	faster	spring & screws OPN #18
3	7.	slower	
	8.	standard	charging valve needle - hand burr hole
	9.	faster	and rethread OPN #5
4	10.	slower	
	11.	standard	check diaphragm travel - thermo diaphragm
	12.	faster	OPN #11
5	13.	slower	
	14.	standard	first bend (600 A cond. outlet conn.)
	15.	faster	OPN #11
6	16.	slower	
	17.	standard	center folding 600 A liner - fold OPN #5
	18.	standard	

Careful analysis was made of the films for the proper allowances of each film and for the proper lengths of each cycle. The following total allowance<sup>5</sup> was used for each job.

Job	Film	Allowance
1	1, 2, 3	14%
2	4, 5, 6	15%
3	7, 8, 9	12%
4	10, 11, 12	12%
5	13, 14, 15	10%
6	16, 17, 18	19%

<sup>5</sup> These are the allowances required when the jobs were rated against a single-pace standard. See Mundel, R. E., op. cit., Chap. 13.

and in the case of the latter, the time was determined by a stopwatch. They consisted of films which the Company considered standard for each of the six jobs and other films from which short loops of each of the jobs at a faster and slower rate could be obtained.

The films were:		Name of Job	
18.	standard	counter folding 600 A liner - fold 600 A	18.
17.	standard		17.
16.	slower		16.
15.	faster		15.
14.	standard	first band (600 A cond. outlet conn.)	14.
13.	slower		13.
12.	faster		12.
11.	standard	check diaphragm travel - (thru diaphragm)	11.
10.	slower		10.
9.	faster	charging valve handle - hand pump hole and retract 600 A	9.
8.	standard		8.
7.	slower		7.
6.	faster	assembly of thermo body, drive shaft, spring & screws 600 A	6.
5.	slower		5.
4.	slower		4.
3.	faster	band 600 A	3.
2.	standard	comp. 1st. inlet hand form 600 A	2.
1.	slower		1.

careful analysis was made of the film for the proper alignment of each film and for the proper lengths of each cycle. The following total allowances were used for each job.

Job	Time	Allowance
1	1.5	1.5
2	2.0	2.0
3	2.5	2.5
4	3.0	3.0
5	3.5	3.5
6	4.0	4.0
7	4.5	4.5
8	5.0	5.0
9	5.5	5.5
10	6.0	6.0
11	6.5	6.5
12	7.0	7.0
13	7.5	7.5
14	8.0	8.0
15	8.5	8.5
16	9.0	9.0
17	9.5	9.5
18	10.0	10.0

These are the allowances required when the jobs were first started. A single-face standard. See Manual, p. 11, 12, 13.

In determining the allowances, the following factors were considered: personal time, amount of body used, foot pedals, bimanualness, eye and hand coordination, handling requirements, weight handled, and percent of cycle controlled by machine.

The above 18 films were edited and calibrated by Tis and Radkins.<sup>6</sup>

To aid in the classification of the rating data, all the engineers at the work session filled out the questionnaire shown in the Appendix.

The questionnaire was discussed in detail by Borrus.<sup>7</sup> In order to evaluate X Company ratings the following sub-groups were used:

1. Area
  - Northern Midwest
  - Central Midwest
  - Southern Midwest
  - Michigan
2. Experience
  - 0 - 6 Months
  - 6 Months - 2 Years
  - 2 - 4 Years
  - Over 4 Years
3. Rating Concept
  - Own Concept
  - Film or Other
4. Training
  - College
  - Company
5. Number of Employees
  - Under 200
  - 200 - 1000
  - Over 1000

<sup>6</sup> Radkins, A. P., Comparison and Evaluation of Three Rating Techniques, Thesis, Purdue University, 1950.

<sup>7</sup> Borrus, B. B., The Present State of Time Study, Thesis, Purdue University, 1950.

to the degree of difficulty, the subject, and the environment.  
 personnel of the subject, the subject, the environment, and  
 part accounting for the environment, weight handling, and percent of  
 cycle controlled by machine.

The above 15 items were edited and edited by the and machine.

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 the work session filled out the questionnaire shown in the Appendix.  
 The questionnaire was discussed in detail by Barnes. In order to obtain  
 the 15 items ratings the following sub-groups were used:

1. Area
  - Northern Midwest
  - Central Midwest
  - Southern Midwest
  - Midwest
2. Experience
  - 0 - 5 Years
  - 6 Months - 5 Years
  - 6 - 10 Years
  - Over 10 Years
3. Rating Concept
  - Own Concept
  - Rating or Other
4. Training
  - College
  - Company
5. Number of Employees
  - Under 500
  - 500 - 1000
  - Over 1000

6. Barnes, A. P., Comparison and Evaluation of Three Rating Techniques,  
 Thesis, Purdue University, 1950.
7. Barnes, A. P., The Present State of Time Study, Thesis, Purdue  
 University, 1950.



5. Size of Town  
 Under 5000  
 5000 - 10,000  
 10,000 - 25,000  
 25,000 - 50,000  
 50,000 - 100,000  
 Over 100,000

A series of 12 films of the same job were calibrated by the engineers. These films were used as the basis for the single and multi-image standards in the latter phases of the work session.<sup>8</sup> The corrected ratings of the engineers with one year, or more, experience were used to establish these bench marks.

The 18 films of X Company's six jobs of three pages each were then shown to the engineers in random order. They were asked to rate these films by whatever method they were accustomed to use. Their ratings were converted to the base of 150, the numerical designation given to the maximum average pace, and recorded upon IBM cards. The films were shown at 1000 cycles per minute and the speed was maintained constant by means of a stroboscope. No indications whatsoever, of the proper ratings, were given to the group.

Similarly, the 18 films of X Company were shown a second time. The engineers were requested to rate using the Mundel system<sup>9</sup> with the single-image film, as a standard bench mark of 100 per cent. This aid was the one of the twelve films which they had previously rated as 100 on the base of 150 as the numerical designation given to the maximum

<sup>8</sup> Lockett, L. H., An Evaluation of Time Study Ratings Made by a Group of Typical Time Study Engineers, Thesis, Purdue University, 1950.

<sup>9</sup> Mundel, H. W., op. cit.



average pace. Later, they were asked to repeat the rating of 15 films using a multi-image film consisting of the 12 paces that they had previously calibrated. Each was given a calibration chart (see Appendix) to aid in the rating. For details of the above three methods of rating, judgment, single aid, and multi-aid consult the theses of Sla,<sup>10</sup> Sherwood<sup>11</sup> and Greenburger.<sup>12</sup> For a comparison of the three methods consult the thesis of Radkins.<sup>13</sup>

10 Sla, A. J., An Analysis of Current Practice Time Study Ratings, Thesis, Purdue University, 1950.

11 Sherwood, W. G., An Evaluation of a Single Standard, Single Image Rating Aid for Time Study Rating, Thesis, Purdue University, 1950.

12 Greenburger, F. R., An Evaluation of the Mundel Multi-Image Rating Loop, Thesis, Purdue University, 1950.

13 Radkins, A. P., op. cit.

1. The first of these is the fact that the data are not normally distributed. The data are skewed to the right, with a long tail of high values. This is evident from the histogram and the normal probability plot. The normal probability plot shows that the data are not normally distributed, as the points do not fall on a straight line. This is a common problem in regression analysis, and it can lead to biased estimates of the parameters and incorrect inferences. One way to deal with this problem is to use a non-linear regression model, such as a generalized linear model (GLM) or a generalized additive model (GAM). These models can handle non-normal data and can provide more accurate estimates of the parameters and more reliable inferences. Another way to deal with this problem is to use a transformation of the data, such as a log transformation or a square root transformation. These transformations can make the data more normally distributed and can improve the fit of the linear regression model. However, it is important to be careful when using transformations, as they can change the interpretation of the parameters and the inferences. In this case, the data are skewed to the right, and a log transformation might be appropriate. However, it is important to check the results of the log transformation to make sure that it is appropriate for the data. In conclusion, the first of the three problems is that the data are not normally distributed. This is a common problem in regression analysis, and it can lead to biased estimates of the parameters and incorrect inferences. One way to deal with this problem is to use a non-linear regression model, such as a generalized linear model (GLM) or a generalized additive model (GAM). These models can handle non-normal data and can provide more accurate estimates of the parameters and more reliable inferences. Another way to deal with this problem is to use a transformation of the data, such as a log transformation or a square root transformation. These transformations can make the data more normally distributed and can improve the fit of the linear regression model. However, it is important to be careful when using transformations, as they can change the interpretation of the parameters and the inferences. In this case, the data are skewed to the right, and a log transformation might be appropriate. However, it is important to check the results of the log transformation to make sure that it is appropriate for the data.

To obtain more info on this subject, please contact the following:

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~~has been shown that it is necessary to~~ ~~to students and~~ ~~to students~~

2. only want to stand out five

1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 84

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[illegible]

## DATA

The data were classified by means of the questionnaire. The following questions and subgroups were used to evaluate the ratings of the work session and to determine the differences, if any existed, between the ratings of the various subgroups and the ratings of A Company:

## Question number 4) Area.

1. Northern Midwest except Michigan
2. Central Midwest
3. Southern Midwest
4. Michigan

## 6) Number of Employees in Plant.

1. Under 200
2. 200 to 1000
3. Over 1000

## 7) Length of Time You Have Been Taking Time Study.

1. Less than 6 Months actively engaged
2. 6 Months to 2 Years
3. 2 to 4 Years
4. Over 4 Years

## 8) Where Did You Receive Your Initial Time Study Training?

1. College
2. Company
3. Extension

## 11) With What Is Your Rating Compared?

1. Your concept of standard performance
2. Some film or other embodiment of standard performance

## 71) Size of Town in which Plant is Located.

1. Under 5000
2. 5000 - 10,000
3. 10,000 - 25,000
4. 25,000 - 50,000
5. 50,000 - 100,000
6. Over 100,000

International Business Machine equipment was used to sort and to tabulate the results for the above groupings.

The data were classified by means of the questionnaire. The following questions and subgroups were used to evaluate the ratings of the work session and to determine the differences, if any existed, between the ratings of the various subgroups and the ratings of a company:

Question number 1) Area:

1. Northern Midwest except Michigan
2. Central Midwest
3. Southern Midwest
4. Michigan

2) Number of employees in plant:

1. Under 500
2. 500 to 1000
3. Over 1000

3) Length of time you have been doing this study:

1. Less than 6 months actively engaged
2. 6 months to 1 year
3. 1 to 2 years
4. Over 2 years

4) Where did you receive your initial time study training?

1. College
2. Company
3. Extension

5) With what is your rating compared?

1. Your concept of standard performance
2. Some firm or other embodiment of standard performance

6) Size of town in which plant is located:

1. Under 5000
2. 5000 - 10,000
3. 10,000 - 25,000
4. 25,000 - 50,000
5. 50,000 - 100,000
6. Over 100,000

Information Business Machine equipment was used to sort and to tabulate the results for the above groupings.

Corrected ratings were obtained from the average ratings by application of the formula  $y' = \frac{y \sum xy}{\sum y^2}$ . For derivation of this formula see Margolin.<sup>14</sup> The corrected means were determined for all films using all three methods of rating for each of the above subgroups. For details see Ela,<sup>15</sup> Sherwood<sup>16</sup> and Greenburger's theses.<sup>17</sup>

In evaluating the ratings assigned by X Company to the three paces of the six industrial jobs, the ratings had to be converted to the same scale as used at the work session. In addition, allowances had to be added to the ratings where the single-image and the multi-image were used to make them comparable. The above was necessary because of differences between the Mundel and X Company definitions and concepts of the standard job and the maximum pace.

Company X states that the standard shall be such that "guaranteed piece work prices shall be set so that a normal employee or group of employees possessing normal skill and training, working under normal conditions, may by normal incentive effort, after making an honest effort to attain incentive earning over a reasonable trial period, have an opportunity to earn per pay period approximately 50% above his piece work base rate or their piece work base rates".<sup>18</sup> Standard is defined by X Company as the time taken when the worker is earning this 50% increment. Dr. Mundel gives as his standard "the amount of time that will be necessary to

<sup>14</sup> Margolin, L., A Comparison of Two Methods of Presentation for Time Study Rating, Thesis, Purdue University, 1950.

<sup>15</sup> Ela, A. J., op. cit.

<sup>16</sup> Sherwood, H. G., op. cit.

<sup>17</sup> Greenburger, F., op. cit.

<sup>18</sup> Contract between Y Union and X Company, 1949.

corrected ratings were obtained from the average ratings by applying  
 the formula  $R = \frac{1}{2}(R_1 + R_2)$ . The corrected ratings were determined for all films using  
 all three methods of rating for each of the above subgroups. For  
 details see the, 12. Thorndike and Greenwood's theses. 17

In evaluating the ratings assigned by X Company to the three pieces of  
 the six industrial jobs, the ratings had to be converted to the same  
 scale as used at the work situation. In addition, allowances had to be  
 added to the ratings where the single-image and the multi-image were  
 used to make them comparable. The above was necessary because of  
 differences between the Munsell and X Company definitions and concepts of  
 the standard job and the maximum pace.

Company X states that the standard shall be such that "Guaranteed piece  
 work piece shall be set so that a normal employee or group of employees  
 possessing normal skill and training, working under normal conditions,  
 may by normal incentive effort, after making an honest effort to attain  
 incentive earnings over a reasonable trial period, have an opportunity to  
 earn per pay period approximately 20% above his piece work base rate or  
 their piece work base rate." 18 Standard is defined by X Company as the  
 time taken when the worker is earning this 20% increment. Dr. Munsell  
 gives as his standard the amount of time that will be necessary to

14. Munsell, L. L. A Comparison of Two Methods of Presentation for  
 Time Study Rating. Thesis, Purdue University, 1930.
15. Thorndike, L. L. op. cit.
16. Thorndike, L. L. op. cit.
17. Greenwood, W. L. op. cit.
18. Contract between Y Union and X Company, 1939.



perform a unit of work, using a given method, under given conditions of work, by a worker possessing sufficient skill to perform the job properly, as physically fit for the job after adjustment to it as the average person who can be expected to be put on the job and working at a pace 100/150 per cent below the maximum pace that can be maintained day after day, without physical effects".<sup>19</sup>

These definitions indicate that there will be differences in the numerical value given to standard performance; i. e., a rating of 66.7 per cent with X Company is equal to 100 per cent Mundel except for the effect of Mundel's secondary adjustments. Company X rates the whole job compared to their concept of normal as indicated above. Mundel proposes a two-step rating procedure called objective rating. The steps are:

1. "The rating of observed pace against an objective pace-standard which is the same for all jobs. In this rating no attention whatsoever is paid to job difficulty and its effect on possible pace, hence, a single pace-standard may be used instead of a multiplicity of mental concepts.
2. "The use of a secondary adjustment, consisting of a percentage increment, added after the application of the numerical appraisal from step one has been used to adjust the original observed data. This percentage increment is to be taken from experimentally determined tables of the effect of various observable factors which control the exertion required at a given pace."<sup>20</sup> Hence, the true

19 Mundel, M. S., op. cit.

20 Mundel, M. S., Motion and Time Study Principles and Practice, New York, Prentice-Hall, 1950.

These definitions indicate that there will be differences in the manner-  
and after testing procedure called objective testing. The steps are:  
1. The subject is placed in a position of rest.  
2. The subject is placed in a position of rest.  
3. The subject is placed in a position of rest.  
4. The subject is placed in a position of rest.  
5. The subject is placed in a position of rest.  
6. The subject is placed in a position of rest.  
7. The subject is placed in a position of rest.  
8. The subject is placed in a position of rest.  
9. The subject is placed in a position of rest.  
10. The subject is placed in a position of rest.

1. "The rating of observed face against an objective face-standard which is the same for all jobs. In this rating no attention whatsoever is paid to job difficulty and its effect on possible bias, hence, a single face-standard may be used instead of a multiplicity of mental concepts.
2. "The use of a secondary adjustment, consisting of a percentage increment, added after the application of the numerical appraisal from step one has been used to adjust the original observed data. This percentage increment is to be taken from experimentally determined tables of the effect of various observable factors which control the reaction required at a given face. Hence, the true

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equivalent of 66.7 per cent rating of Company in practice would be a case wherein the Mundel system rating multiplied by one plus the secondary adjustment given as decimals equaled 100 per cent.

From the above we see that the company's problem and work session item #3 was to rate the whole job including an appraisal of difficulty, while the work session, items 4 and 5<sup>21</sup>, simply rated the pace of the given job and required secondary adjustments for differences in job difficulty from the standard job to make the data comparable. After making the following corrections to the data: (1) conversion of X Company ratings to the base 130 maximum average pace and (2) application of allowances to single-image and multi-image ratings, the ratings of the company were compared to the three work session ratings by means of comparison graphs and least squares lines<sup>22</sup> to determine any differences, if such existed, due to area, concept of standard, type of company, method of rating, number of employees and size of town.

To determine if such results could reasonably be ascribed to chance or were statistically significant,<sup>23</sup> "t" tests were made upon the results of the above comparisons.

21 Mundel, M. E., (Editor), Report of Fifth Annual Motion and Time Study Work Session, Purdue University, 1950.

22 Tiffin, J., op. cit.

23 Peters, C. C. and Van Voorhis, W. R., Statistical Procedures and their Mathematical Bases, McGraw-Hill Book Co., Inc., New York, 1940, p. 165.

the company in previous years  
 as a result of the company's policy of  
 the company, which was given a discount of 100 per cent.

From the above it can be seen that the company's policy and work system  
 was to raise the whole lot including an appraisal of difficulty, while

the work system, items 4 and 5<sup>21</sup>, simply rated the ease of the given  
 job and required secondary adjustments for differences in the difficulty

from the standard job to make the data comparable. After making the  
 following correction to the data: (1) conversion of a company rating

to the base 100 maximum average time and (2) application of allowances  
 for single-image and multi-image ratings, the ratings of the company were  
 compared to the three work system ratings by means of comparison graphs  
 and least squares lines<sup>22</sup> to determine any differences, if such existed,

due to area, concept of standard, type of company, method of rating,

number of employees and size of town.

To determine if such results could reasonably be ascribed to chance or  
 were statistically significant,<sup>23</sup>  $\chi^2$  tests were made upon the results  
 of the above comparisons.

21. Handbook, W. L. (Editor), Reports of 1919 Annual Motion and Time  
Study Work Research, Purdue University, 1920.  
 22. W. L. Hand, "The Statistical Treatment of Experimental Data,"  
McGraw-Hill Book Co., Inc., New York, 1930, p. 167.  
 23. Handbook, W. L. (Editor), Reports of 1919 Annual Motion and Time  
Study Work Research, Purdue University, 1920.

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In the comparison of the best approximation of 100 by work session using the various techniques and X Company's concept of standard, the following results were obtained:

Per Cent X Company Differs From Work Session:

| Job Number          | Judgment Rating | Single-Image | Multi-Image |
|---------------------|-----------------|--------------|-------------|
| 1                   | 25%             | -14%         | -14%        |
| 2                   | 20              | 10           | 1           |
| 3                   | 16              | 37           | 27          |
| 4                   | 16              | 10           | - 1         |
| 5                   | 8               | 0            | - 5         |
| 6                   | 21              | 21           | - 9         |
| <hr/>               |                 |              |             |
| Average Differences | 17.5%           | 10.7%        | - 0.17%     |

Note: See p. 5 for job name to identify above job number.

In the comparison of the band absorption of 100 by water solution  
using the various techniques and Company's concept of standard, the  
following results were obtained:

For Band X Company Differs from Water Solution:

| Job Number | Single-Image<br>-14% | Multi-Image<br>-14% |
|------------|----------------------|---------------------|
| 1          | 25                   | 25                  |
| 2          | 20                   | 20                  |
| 3          | 18                   | 18                  |
| 4          | 16                   | 16                  |
| 5          | 6                    | 6                   |
| 6          | 21                   | 21                  |

Average Difference 17.5% 10.4% - 0.1%

Note: See p. 2 for job name to identify above job number.

## DISCUSSION

Factors that might have affected the results of the work session ratings were:

1. Since the engineers rated all day and did not use the multi-image technique until late in the afternoon, fatigue probably affected their ratings.
2. The possible influence of the seating arrangement was not considered.
3. The training curve was not considered. In the use of the new techniques, Greenburger<sup>24</sup> mentioned that consistency and accuracy improved with practice when using multi-image aid.
4. The difference in the size of multi-image individual pictures and the job picture may have been a factor. However, Radkins<sup>25</sup> stated that there was no significant difference between the three techniques (judgment, single aid and multi-aid) in regard to accuracy and consistency of ratings.

The conclusions drawn from this experiment, within the preceding limitations are:

1. In the comparison of the best approximation of 100 by the work session using the judgment technique and X Company's concept of standard, the company averaged 17.3 per cent higher on the six jobs. Statistical "t" tests indicate that this difference is significant at the 5 per cent level. In other words, this differ-

<sup>24</sup> Greenburger, F. R., op. cit.

<sup>25</sup> Radkins, A. P., op. cit.

technique that they have selected the training of this work session ratings

work

1. Since the technique rated all day and did not use the multi-image technique until late in the afternoon, ratings probably reflected their ratings.

2. The possible influence of the seating arrangement was not considered.

3. The training curve was not considered. In the use of the new technique, Greenberger<sup>24</sup> mentioned that consistency and accuracy improved with practice when using multi-image aids.

4. The difference in the size of multi-image individual photographs and the job picture may have been a factor. However, Haskins<sup>25</sup> stated that there was no significant difference between the three techniques (judgment, single aid and multi-aid) in regard to accuracy and consistency of ratings.

The conclusions drawn from this experiment, within the preceding limitations are:

1. In the comparison of the post approximation of 100 by the work session using the judgment technique and a company's concept of standards, the company averaged 17.5 per cent higher on the six jobs. Statistical tests indicate that this difference is significant at the 5 per cent level. In other words, this difference

<sup>24</sup> Greenberger, G. B., op. cit.

<sup>25</sup> Haskins, A. P., op. cit.



error could occur by chance only one time in twenty or less. In addition, Ela<sup>26</sup> found that 43 per cent of the work session engineers rated within  $\pm 5$  per cent, 65.4 within  $\pm 7.5$ , 58.5 within  $\pm 10$  and 84.6 per cent within  $\pm 20$  per cent of the overall means to which the X Company ratings were compared above.

2. In the comparison of the best approximation of 100 by the work session using the single-image bench mark and X Company's concept of standard, the company averaged 10.7 per cent higher on the six jobs. In the statistical "t" test, "t" was 0.61 which means that there was no statistically reliable difference between the two concepts of standard. Sherwood<sup>27</sup> found that 33 per cent of the work session engineers rated within  $\pm 5$  per cent, 48 per cent within  $\pm 7\frac{1}{2}$  per cent, 58 within  $\pm 10$  and 89 within  $\pm 20$  of the overall means to which the X Company ratings were compared above.
3. There was no appreciable difference in the concepts of standards between the ratings of the work session, using the Mundel<sup>28</sup> method of rating with the multi-image bench mark, and the X Company. In the comparison of the best approximation of 100 by the work session and the company, the latter averaged 0.17 per cent lower on the six jobs. However, job number three was 27 per cent higher than work session mean rating. Greenberger<sup>29</sup> found that 36 per cent of the work session engineers rated within  $\pm 5$  per cent,

26 Ela, A. J., op. cit.

27 Sherwood, W. G., op. cit.

28 Mundel, M. E., op. cit.

29 Greenberger, E., op. cit.

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10. The results of the above tests are summarized in Table 1. The results show that the average rate of flow of water through the soil was 0.001 cm. per second. The average rate of flow of water through the soil was 0.001 cm. per second. The average rate of flow of water through the soil was 0.001 cm. per second.

above.

There was no appreciable difference in the number of standard deviations between the ratings of the two sessions, using the number 100 as the basis of rating with the white-image search card, and the 1000 as the basis of the dark approximation of 100 of the same session and the category, the latter averaged 0.17 per cent lower on the six trials. However, the number three was 1.7 per cent higher than the rating on the six trials. Consequently, it was found that the number of standard deviations rated within  $\pm 1$  per cent.

47 within  $\pm 7\frac{1}{2}$ , 62 within  $\pm 10$ , and 90 within  $\pm 20$  per cent of the overall means to which the X Company ratings were compared above.

In regard to the other parameters under investigation (area, training, number of employees, experience, concept of standard, and size of town) only the following were found to be significantly different from their respective "overall" work session ratings to warrant using for comparison with X Company ratings:

1. In analyzing the judgment technique ratings, Ela<sup>30</sup> found only the Michigan group significantly different from the overall ratings. When compared to X Company, the Michigan group using judgment were not significantly different from X Company. The company ratings were 9 per cent higher on the average.
2. In the use of the single-image aid as a bench mark, Sherwood<sup>31</sup> found Michigan area and the college and company training significantly different from the "overall" work session ratings. However, when compared with X Company ratings the Michigan single-image ratings were not significantly different. The company ratings were 1.7 per cent higher on the average. Also, both the college and the company trained men appeared not statistically significantly different at the one per cent level when compared to the X Company. The X Company differed from them by 16.85 and 15.25 per cent higher, respectively.

30 Ela, A. J., op. cit.

31 Sherwood, W. G., op. cit.

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in regard to the above mentioned investigation (see, Exhibit  
number of my report, references, summary of findings, and also of town  
only the following were found to be significantly different from their  
respective "overall" work situation ratings to warrant being for comparison

1. In analyzing the judgment evidence relative, the following points are noted:

and 17.5% per cent higher, respectively. The company differed from them by 10.3% slightly different at low and per cent level when compared outside and the company business was reported not satisfactorily ratios were 1.7 per cent higher on the average. Also, both the large ratios were not significantly different. The company even, when compared with company ratings the highest single entity different from the "overall" work session ratings. Some ratings were and the ratings and company ratings slightly in the case of the single-ratio and as a result with, respectively.

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3. Although Greenburger found that when the work session engineers used the multi-image bench mark, the Michigan area, and the college and company trained men were significantly different from the "overall" ratings, when compared to X Company there was no statistical significance. The company ratings were 1.7, 9 and 6.8 per cent higher respectively than the above subgroups.

Note: It was unfortunate that there was available only one X Company rating for each film and therefore no check on the internal consistency of the ratings of X Company engineers could be made by comparison with the work session ratings.

There was a significant difference in the work session ratings

and the ratings of the work session, and the

ratings of the work session were significantly different

from the "overall" ratings, when compared to 1 Company there was

no statistical significance. The company ratings were 1.7, 2 and

2.8 per cent higher respectively than the above subgroups.

Note: It was unfortunate that there was available only one 1 Company

rating for each film and therefore no check on the internal con-

sistency of the ratings of 1 Company engineers could be made by

comparison with the work session ratings.

**APPENDIX**

(1944)

1944-1945

1944-1945 (1944-1945)

1944-1945 (1944-1945)

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XIX



T 1

V All

| Film No. | Co. Rating Base 150 | Own Con-<br>cept Wk.<br>Session Rating V. | 1+Allow.<br>(Multi) | Corrected Single-<br>Image Rating | Corrected Single<br>Image Rating Allow. | Corrected Multi-<br>Image Rating | Corrected Multi-<br>Image Rating & Allow. |
|----------|---------------------|---|---------------------|-----------------------------------|---|----------------------------------|---|
| 1        | 127                 | 104                                       | 1.14                | 98                                | 112                                     | 100                              | 114                                       |
| 2        | 130                 | 105                                       |                     | 100                               | 114                                     | 102                              | 116                                       |
| 3        | 151                 | 122                                       |                     | 115                               | 131                                     | 118                              | 134                                       |
| 4        | 104                 | 87  | 1.15                | 83                                | 94                                      | 91                               | 103                                       |
| 5        | 130                 | 109                                       |                     | 105                               | 119                                     | 114                              | 129                                       |
| 6        | 172                 | 144                                       |                     | 138                               | 156                                     | 150                              | 170                                       |
| 7        | 116                 | 90  | 1.12                | 73                                | 84                                      | 81                               | 91  |
| 8        | 130                 | 101                                       |                     | 85                                | 95                                      | 91                               | 102                                       |
| 9        | 150                 | 116                                       |                     | 97                                | 109                                     | 105                              | 118                                       |
| 10       | 121                 | 104                                       | 1.12                | 97                                | 109                                     | 110                              | 123                                       |
| 11       | 130                 | 112                                       |                     | 105                               | 118                                     | 118                              | 132                                       |
| 12       | 167                 | 143                                       |                     | 134                               | 150                                     | 152                              | 170                                       |
| 13       | 117                 | 100                                       | 1.10                | 106                               | 117                                     | 110                              | 121                                       |
| 14       | 130                 | 120                                       |                     | 117                               | 129                                     | 121                              | 133                                       |
| 15       | 123                 | 114                                       |                     | 111                               | 122                                     | 115                              | 126                                       |
| 16       | 138                 | 107                                       | 1.19                | 96                                | 114                                     | 109                              | 120                                       |
| 17       | 143                 | 115                                       |                     | 104                               | 124                                     | 115                              | 124                                       |
| 18       | 143                 | 115                                       |                     | 104                               | 124                                     | 115                              | 124                                       |

Note: See p. 5 for names of films to identify above film numbers.

| Station | Time | Lat | Long | Alt  | Temp | Wind | Clouds | Remarks |
|---------|------|-----|------|------|------|------|--------|---------|
| 101     | 001  | 111 | 00   | 11.1 | 101  | 101  | 101    |         |
| 102     | 002  | 112 | 001  |      | 102  | 102  | 102    |         |
| 103     | 003  | 113 | 001  |      | 103  | 103  | 103    |         |
| 104     | 004  | 114 | 001  |      | 104  | 104  | 104    |         |
| 105     | 005  | 115 | 001  |      | 105  | 105  | 105    |         |
| 106     | 006  | 116 | 001  |      | 106  | 106  | 106    |         |
| 107     | 007  | 117 | 001  |      | 107  | 107  | 107    |         |
| 108     | 008  | 118 | 001  |      | 108  | 108  | 108    |         |
| 109     | 009  | 119 | 001  |      | 109  | 109  | 109    |         |
| 110     | 010  | 120 | 001  |      | 110  | 110  | 110    |         |
| 111     | 011  | 121 | 001  |      | 111  | 111  | 111    |         |
| 112     | 012  | 122 | 001  |      | 112  | 112  | 112    |         |
| 113     | 013  | 123 | 001  |      | 113  | 113  | 113    |         |
| 114     | 014  | 124 | 001  |      | 114  | 114  | 114    |         |
| 115     | 015  | 125 | 001  |      | 115  | 115  | 115    |         |
| 116     | 016  | 126 | 001  |      | 116  | 116  | 116    |         |
| 117     | 017  | 127 | 001  |      | 117  | 117  | 117    |         |
| 118     | 018  | 128 | 001  |      | 118  | 118  | 118    |         |
| 119     | 019  | 129 | 001  |      | 119  | 119  | 119    |         |
| 120     | 020  | 130 | 001  |      | 120  | 120  | 120    |         |
| 121     | 021  | 131 | 001  |      | 121  | 121  | 121    |         |
| 122     | 022  | 132 | 001  |      | 122  | 122  | 122    |         |
| 123     | 023  | 133 | 001  |      | 123  | 123  | 123    |         |
| 124     | 024  | 134 | 001  |      | 124  | 124  | 124    |         |
| 125     | 025  | 135 | 001  |      | 125  | 125  | 125    |         |

Notes: See p. 2 for names of ships to identify above ship numbers.

TABLE 2

## Area Ratings Using Judgment

| Film No. | Group 1 | Group 2 | Group 3 | Group 4 |
|----------|---------|---------|---------|---------|
| 1        | 101     | 101     | 107     | 114     |
| 2        | 103     | 102     | 109     | 116     |
| 3        | 119     | 118     | 126     | 134     |
| 4        | 84      | 85      | 92      | 95      |
| 5        | 106     | 106     | 115     | 119     |
| 6        | 139     | 140     | 152     | 157     |
| 7        | 88      | 90      | 90      | 93      |
| 8        | 99      | 101     | 100     | 105     |
| 9        | 113     | 116     | 115     | 120     |
| 10       | 105     | 102     | 106     | 111     |
| 11       | 111     | 110     | 114     | 120     |
| 12       | 142     | 140     | 146     | 155     |
| 13       | 111     | 105     | 110     | 111     |
| 14       | 123     | 116     | 122     | 123     |
| 15       | 116     | 110     | 116     | 117     |
| 16       | 108     | 103     | 111     | 113     |
| 17       | 116     | 111     | 119     | 121     |
| 18       | 116     | 111     | 119     | 121     |

Note: See p. 5 for the names of the films.

5 10 15

through the middle of the group

| Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---------|---------|---------|---------|---------|
| 101     | 101     | 101     | 101     | 101     |
| 102     | 102     | 102     | 102     | 102     |
| 103     | 103     | 103     | 103     | 103     |
| 104     | 104     | 104     | 104     | 104     |
| 105     | 105     | 105     | 105     | 105     |
| 106     | 106     | 106     | 106     | 106     |
| 107     | 107     | 107     | 107     | 107     |
| 108     | 108     | 108     | 108     | 108     |
| 109     | 109     | 109     | 109     | 109     |
| 110     | 110     | 110     | 110     | 110     |
| 111     | 111     | 111     | 111     | 111     |
| 112     | 112     | 112     | 112     | 112     |
| 113     | 113     | 113     | 113     | 113     |
| 114     | 114     | 114     | 114     | 114     |
| 115     | 115     | 115     | 115     | 115     |
| 116     | 116     | 116     | 116     | 116     |
| 117     | 117     | 117     | 117     | 117     |
| 118     | 118     | 118     | 118     | 118     |
| 119     | 119     | 119     | 119     | 119     |
| 120     | 120     | 120     | 120     | 120     |
| 121     | 121     | 121     | 121     | 121     |
| 122     | 122     | 122     | 122     | 122     |
| 123     | 123     | 123     | 123     | 123     |
| 124     | 124     | 124     | 124     | 124     |
| 125     | 125     | 125     | 125     | 125     |
| 126     | 126     | 126     | 126     | 126     |
| 127     | 127     | 127     | 127     | 127     |
| 128     | 128     | 128     | 128     | 128     |
| 129     | 129     | 129     | 129     | 129     |
| 130     | 130     | 130     | 130     | 130     |
| 131     | 131     | 131     | 131     | 131     |
| 132     | 132     | 132     | 132     | 132     |
| 133     | 133     | 133     | 133     | 133     |
| 134     | 134     | 134     | 134     | 134     |
| 135     | 135     | 135     | 135     | 135     |
| 136     | 136     | 136     | 136     | 136     |
| 137     | 137     | 137     | 137     | 137     |
| 138     | 138     | 138     | 138     | 138     |
| 139     | 139     | 139     | 139     | 139     |
| 140     | 140     | 140     | 140     | 140     |
| 141     | 141     | 141     | 141     | 141     |
| 142     | 142     | 142     | 142     | 142     |
| 143     | 143     | 143     | 143     | 143     |
| 144     | 144     | 144     | 144     | 144     |
| 145     | 145     | 145     | 145     | 145     |
| 146     | 146     | 146     | 146     | 146     |
| 147     | 147     | 147     | 147     | 147     |
| 148     | 148     | 148     | 148     | 148     |
| 149     | 149     | 149     | 149     | 149     |
| 150     | 150     | 150     | 150     | 150     |
| 151     | 151     | 151     | 151     | 151     |
| 152     | 152     | 152     | 152     | 152     |
| 153     | 153     | 153     | 153     | 153     |
| 154     | 154     | 154     | 154     | 154     |
| 155     | 155     | 155     | 155     | 155     |
| 156     | 156     | 156     | 156     | 156     |
| 157     | 157     | 157     | 157     | 157     |
| 158     | 158     | 158     | 158     | 158     |
| 159     | 159     | 159     | 159     | 159     |
| 160     | 160     | 160     | 160     | 160     |
| 161     | 161     | 161     | 161     | 161     |
| 162     | 162     | 162     | 162     | 162     |
| 163     | 163     | 163     | 163     | 163     |
| 164     | 164     | 164     | 164     | 164     |
| 165     | 165     | 165     | 165     | 165     |
| 166     | 166     | 166     | 166     | 166     |
| 167     | 167     | 167     | 167     | 167     |
| 168     | 168     | 168     | 168     | 168     |
| 169     | 169     | 169     | 169     | 169     |
| 170     | 170     | 170     | 170     | 170     |
| 171     | 171     | 171     | 171     | 171     |
| 172     | 172     | 172     | 172     | 172     |
| 173     | 173     | 173     | 173     | 173     |
| 174     | 174     | 174     | 174     | 174     |
| 175     | 175     | 175     | 175     | 175     |
| 176     | 176     | 176     | 176     | 176     |
| 177     | 177     | 177     | 177     | 177     |
| 178     | 178     | 178     | 178     | 178     |
| 179     | 179     | 179     | 179     | 179     |
| 180     | 180     | 180     | 180     | 180     |
| 181     | 181     | 181     | 181     | 181     |
| 182     | 182     | 182     | 182     | 182     |
| 183     | 183     | 183     | 183     | 183     |
| 184     | 184     | 184     | 184     | 184     |
| 185     | 185     | 185     | 185     | 185     |
| 186     | 186     | 186     | 186     | 186     |
| 187     | 187     | 187     | 187     | 187     |
| 188     | 188     | 188     | 188     | 188     |
| 189     | 189     | 189     | 189     | 189     |
| 190     | 190     | 190     | 190     | 190     |
| 191     | 191     | 191     | 191     | 191     |
| 192     | 192     | 192     | 192     | 192     |
| 193     | 193     | 193     | 193     | 193     |
| 194     | 194     | 194     | 194     | 194     |
| 195     | 195     | 195     | 195     | 195     |
| 196     | 196     | 196     | 196     | 196     |
| 197     | 197     | 197     | 197     | 197     |
| 198     | 198     | 198     | 198     | 198     |
| 199     | 199     | 199     | 199     | 199     |
| 200     | 200     | 200     | 200     | 200     |

Note: See p. 2 for the names of the lines.

TABLE 3

Area Ratings Plus Allowances Using Single Aid

| Film No. | Group 1 | Group 2 | Group 3 | Group 4 |
|----------|---------|---------|---------|---------|
| 1        | 113     | 113     | 112     | 115     |
| 2        | 109     | 114     | 113     | 116     |
| 3        | 128     | 132     | 131     | 135     |
| 4        | 90      | 96      | 99      | 102     |
| 5        | 114     | 121     | 124     | 130     |
| 6        | 150     | 159     | 164     | 171     |
| 7        | 81      | 87      | 91      | 88      |
| 8        | 91      | 97      | 91      | 100     |
| 9        | 104     | 112     | 104     | 114     |
| 10       | 102     | 107     | 112     | 116     |
| 11       | 110     | 116     | 121     | 125     |
| 12       | 141     | 153     | 156     | 160     |
| 13       | 111     | 114     | 114     | 118     |
| 14       | 123     | 127     | 128     | 130     |
| 15       | 117     | 121     | 121     | 125     |
| 16       | 119     | 120     | 118     | 126     |
| 17       | 124     | 125     | 125     | 131     |
| 18       | 124     | 125     | 125     | 131     |



TABLE 4

Area Ratings Plus Allowances Using Multi-Aid

| Film No. | Group 1 | Group 2 | Group 3 | Group 4 |
|----------|---------|---------|---------|---------|
| 1        | 114     | 116     | 108     | 117     |
| 2        | 113     | 117     | 111     | 118     |
| 3        | 133     | 137     | 128     | 138     |
| 4        | 98      | 104     | 102     | 107     |
| 5        | 124     | 131     | 128     | 136     |
| 6        | 164     | 172     | 168     | 179     |
| 7        | 85      | 94      | 84      | 101     |
| 8        | 95      | 105     | 94      | 112     |
| 9        | 110     | 121     | 109     | 129     |
| 10       | 119     | 125     | 121     | 129     |
| 11       | 128     | 134     | 130     | 139     |
| 12       | 164     | 172     | 167     | 177     |
| 13       | 121     | 124     | 113     | 128     |
| 14       | 134     | 138     | 125     | 141     |
| 15       | 128     | 130     | 120     | 134     |
| 16       | 130     | 127     | 131     | 134     |
| 17       | 134     | 132     | 136     | 139     |
| 18       | 134     | 132     | 136     | 139     |

Table 1

Comparison of the results of the two methods

| Group A | Group B | Group C | Group D | Line No. |
|---------|---------|---------|---------|----------|
| 111     | 108     | 110     | 111     | 1        |
| 111     | 111     | 111     | 111     | 2        |
| 111     | 111     | 111     | 111     | 3        |
| 101     | 101     | 101     | 101     | 4        |
| 111     | 111     | 111     | 111     | 5        |
| 111     | 111     | 111     | 111     | 6        |
| 101     | 101     | 101     | 101     | 7        |
| 111     | 111     | 111     | 111     | 8        |
| 111     | 111     | 111     | 111     | 9        |
| 111     | 111     | 111     | 111     | 10       |
| 111     | 111     | 111     | 111     | 11       |
| 111     | 111     | 111     | 111     | 12       |
| 111     | 111     | 111     | 111     | 13       |
| 111     | 111     | 111     | 111     | 14       |
| 111     | 111     | 111     | 111     | 15       |
| 111     | 111     | 111     | 111     | 16       |
| 111     | 111     | 111     | 111     | 17       |
| 111     | 111     | 111     | 111     | 18       |



TABLE 5

## Training Ratings Using Judgment

| Film No. | Group 1 | Group 2 |
|----------|---------|---------|
| 1        | 104     | 105     |
| 2        | 106     | 107     |
| 3        | 122     | 123     |
| 4        | 89      | 87      |
| 5        | 113     | 109     |
| 6        | 149     | 143     |
| 7        | 89      | 91      |
| 8        | 106     | 102     |
| 9        | 114     | 118     |
| 10       | 104     | 105     |
| 11       | 112     | 113     |
| 12       | 144     | 144     |
| 13       | 109     | 109     |
| 14       | 120     | 121     |
| 15       | 114     | 115     |
| 16       | 107     | 108     |
| 17       | 113     | 116     |
| 18       | 113     | 116     |



TABLE 6

Training Ratings Plus Allowances Gain Single-Image Film

| Film No. | Group 1 | Group 2 |
|----------|---------|---------|
| 1        | 109     | 115     |
| 2        | 112     | 114     |
| 3        | 129     | 132     |
| 4        | 96      | 95      |
| 5        | 121     | 120     |
| 6        | 159     | 158     |
| 7        | 82      | 85      |
| 8        | 92      | 96      |
| 9        | 105     | 111     |
| 10       | 109     | 109     |
| 11       | 118     | 116     |
| 12       | 150     | 149     |
| 13       | 112     | 116     |
| 14       | 125     | 128     |
| 15       | 118     | 121     |
| 16       | 119     | 120     |
| 17       | 123     | 125     |
| 18       | 125     | 125     |

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with weight-signals, with frequency, with amplitude, with phase

| Group 3 |     | Group 1 | Group 2 |
|---------|-----|---------|---------|
| 111     | 100 | 100     | 1       |
| 114     | 111 | 111     | 2       |
| 123     | 123 | 123     | 3       |
| 22      | 22  | 22      | 4       |
| 120     | 121 | 121     | 5       |
| 126     | 126 | 126     | 6       |
| 22      | 22  | 22      | 7       |
| 22      | 22  | 22      | 8       |
| 111     | 100 | 100     | 9       |
| 103     | 103 | 103     | 10      |
| 116     | 116 | 116     | 11      |
| 103     | 100 | 100     | 12      |
| 116     | 116 | 116     | 13      |
| 128     | 128 | 128     | 14      |
| 131     | 131 | 131     | 15      |
| 150     | 150 | 150     | 16      |
| 152     | 152 | 152     | 17      |
| 152     | 152 | 152     | 18      |

TABLE 7

Training Ratings Plus Allowances Using Multi-Ins. Film

| Film No. | Group 1 | Group 2 |
|----------|---------|---------|
| 1        | 113     | 115     |
| 2        | 115     | 116     |
| 3        | 132     | 136     |
| 4        | 104     | 102     |
| 5        | 130     | 128     |
| 6        | 171     | 168     |
| 7        | 84      | 94      |
| 8        | 94      | 104     |
| 9        | 109     | 121     |
| 10       | 121     | 124     |
| 11       | 131     | 134     |
| 12       | 167     | 172     |
| 13       | 121     | 120     |
| 14       | 135     | 132     |
| 15       | 127     | 125     |
| 16       | 129     | 130     |
| 17       | 133     | 134     |
| 18       | 133     | 134     |

Table 1. Summary of the data for the 1990-1991 season.

| Year | 1990 | 1991 |
|------|------|------|
| 1990 | 1990 | 1990 |
| 1991 | 1991 | 1991 |
| 1992 | 1992 | 1992 |
| 1993 | 1993 | 1993 |
| 1994 | 1994 | 1994 |
| 1995 | 1995 | 1995 |
| 1996 | 1996 | 1996 |
| 1997 | 1997 | 1997 |
| 1998 | 1998 | 1998 |
| 1999 | 1999 | 1999 |
| 2000 | 2000 | 2000 |
| 2001 | 2001 | 2001 |
| 2002 | 2002 | 2002 |
| 2003 | 2003 | 2003 |
| 2004 | 2004 | 2004 |
| 2005 | 2005 | 2005 |
| 2006 | 2006 | 2006 |
| 2007 | 2007 | 2007 |
| 2008 | 2008 | 2008 |
| 2009 | 2009 | 2009 |
| 2010 | 2010 | 2010 |
| 2011 | 2011 | 2011 |
| 2012 | 2012 | 2012 |
| 2013 | 2013 | 2013 |
| 2014 | 2014 | 2014 |
| 2015 | 2015 | 2015 |
| 2016 | 2016 | 2016 |
| 2017 | 2017 | 2017 |
| 2018 | 2018 | 2018 |
| 2019 | 2019 | 2019 |
| 2020 | 2020 | 2020 |
| 2021 | 2021 | 2021 |
| 2022 | 2022 | 2022 |
| 2023 | 2023 | 2023 |
| 2024 | 2024 | 2024 |
| 2025 | 2025 | 2025 |
| 2026 | 2026 | 2026 |
| 2027 | 2027 | 2027 |
| 2028 | 2028 | 2028 |
| 2029 | 2029 | 2029 |
| 2030 | 2030 | 2030 |
| 2031 | 2031 | 2031 |
| 2032 | 2032 | 2032 |
| 2033 | 2033 | 2033 |
| 2034 | 2034 | 2034 |
| 2035 | 2035 | 2035 |
| 2036 | 2036 | 2036 |
| 2037 | 2037 | 2037 |
| 2038 | 2038 | 2038 |
| 2039 | 2039 | 2039 |
| 2040 | 2040 | 2040 |
| 2041 | 2041 | 2041 |
| 2042 | 2042 | 2042 |
| 2043 | 2043 | 2043 |
| 2044 | 2044 | 2044 |
| 2045 | 2045 | 2045 |
| 2046 | 2046 | 2046 |
| 2047 | 2047 | 2047 |
| 2048 | 2048 | 2048 |
| 2049 | 2049 | 2049 |
| 2050 | 2050 | 2050 |
| 2051 | 2051 | 2051 |
| 2052 | 2052 | 2052 |
| 2053 | 2053 | 2053 |
| 2054 | 2054 | 2054 |
| 2055 | 2055 | 2055 |
| 2056 | 2056 | 2056 |
| 2057 | 2057 | 2057 |
| 2058 | 2058 | 2058 |
| 2059 | 2059 | 2059 |
| 2060 | 2060 | 2060 |
| 2061 | 2061 | 2061 |
| 2062 | 2062 | 2062 |
| 2063 | 2063 | 2063 |
| 2064 | 2064 | 2064 |
| 2065 | 2065 | 2065 |
| 2066 | 2066 | 2066 |
| 2067 | 2067 | 2067 |
| 2068 | 2068 | 2068 |
| 2069 | 2069 | 2069 |
| 2070 | 2070 | 2070 |
| 2071 | 2071 | 2071 |
| 2072 | 2072 | 2072 |
| 2073 | 2073 | 2073 |
| 2074 | 2074 | 2074 |
| 2075 | 2075 | 2075 |
| 2076 | 2076 | 2076 |
| 2077 | 2077 | 2077 |
| 2078 | 2078 | 2078 |
| 2079 | 2079 | 2079 |
| 2080 | 2080 | 2080 |
| 2081 | 2081 | 2081 |
| 2082 | 2082 | 2082 |
| 2083 | 2083 | 2083 |
| 2084 | 2084 | 2084 |
| 2085 | 2085 | 2085 |
| 2086 | 2086 | 2086 |
| 2087 | 2087 | 2087 |
| 2088 | 2088 | 2088 |
| 2089 | 2089 | 2089 |
| 2090 | 2090 | 2090 |
| 2091 | 2091 | 2091 |
| 2092 | 2092 | 2092 |
| 2093 | 2093 | 2093 |
| 2094 | 2094 | 2094 |
| 2095 | 2095 | 2095 |
| 2096 | 2096 | 2096 |
| 2097 | 2097 | 2097 |
| 2098 | 2098 | 2098 |
| 2099 | 2099 | 2099 |
| 2100 | 2100 | 2100 |

TABLE 8

## Number of Employee Ratings Using Judgment

| Film No. | Group 1 | Group 2 | Group 3 |
|----------|---------|---------|---------|
| 1        | 96      | 104     | 102     |
| 2        | 98      | 106     | 104     |
| 3        | 113     | 123     | 120     |
| 4        | 79      | 87      | 87      |
| 5        | 99      | 110     | 109     |
| 6        | 130     | 144     | 143     |
| 7        | 82      | 90      | 89      |
| 8        | 92      | 101     | 100     |
| 9        | 106     | 116     | 113     |
| 10       | 96      | 105     | 103     |
| 11       | 104     | 113     | 111     |
| 12       | 133     | 144     | 142     |
| 13       | 103     | 109     | 107     |
| 14       | 114     | 120     | 118     |
| 15       | 108     | 114     | 112     |
| 16       | 102     | 108     | 106     |
| 17       | 110     | 116     | 114     |
| 18       | 110     | 116     | 114     |

2004

~~XX~~

| Year | 1900 | 1901 | 1902 | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 | 1927 | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 | 1946 | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 | 2080 | 2081 | 2082 | 2083 | 2084 | 2085 | 2086 | 2087 | 2088 | 2089 | 2090 | 2091 | 2092 | 2093 | 2094 | 2095 | 2096 | 2097 | 2098 | 2099 | 2100 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1900 | 1901 | 1902 | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 | 1927 | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 | 1946 | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 | 2080 | 2081 | 2082 | 2083 | 2084 | 2085 | 2086 | 2087 | 2088 | 2089 | 2090 | 2091 | 2092 | 2093 | 2094 | 2095 | 2096 | 2097 | 2098 | 2099 | 2100 |      |



TABLE 9

Number of Employees Ratings Plus Allowances  
Using Single-Image Film

| Film No. | Group 1 | Group 2 | Group 3 |
|----------|---------|---------|---------|
| 1        | 114     | 113     | 111     |
| 2        | 115     | 114     | 112     |
| 3        | 133     | 132     | 130     |
| 4        | 96      | 90      | 94      |
| 5        | 121     | 113     | 119     |
| 6        | 159     | 149     | 156     |
| 7        | 84      | 80      | 82      |
| 8        | 94      | 91      | 92      |
| 9        | 108     | 105     | 105     |
| 10       | 110     | 104     | 108     |
| 11       | 119     | 113     | 116     |
| 12       | 132     | 144     | 149     |
| 13       | 116     | 113     | 112     |
| 14       | 128     | 123     | 124     |
| 15       | 122     | 119     | 118     |
| 16       | 121     | 122     | 118     |
| 17       | 126     | 127     | 121     |
| 18       | 126     | 127     | 121     |

TABLE 1. — *Continued*

| Group 1 | Group 2 | Group 3 | Group 4 |
|---------|---------|---------|---------|
| 111     | 111     | 111     | 1       |
| 112     | 112     | 112     | 2       |
| 113     | 113     | 113     | 3       |
| 114     | 114     | 114     | 4       |
| 115     | 115     | 115     | 5       |
| 116     | 116     | 116     | 6       |
| 117     | 117     | 117     | 7       |
| 118     | 118     | 118     | 8       |
| 119     | 119     | 119     | 9       |
| 120     | 120     | 120     | 10      |
| 121     | 121     | 121     | 11      |
| 122     | 122     | 122     | 12      |
| 123     | 123     | 123     | 13      |
| 124     | 124     | 124     | 14      |
| 125     | 125     | 125     | 15      |
| 126     | 126     | 126     | 16      |
| 127     | 127     | 127     | 17      |
| 128     | 128     | 128     | 18      |
| 129     | 129     | 129     | 19      |
| 130     | 130     | 130     | 20      |

TABLE 10

Number of Employees Ratings Plus Allowances  
Using Multi-Aid Film

| Film No. | Group 1 | Group 2 | Group 3 |
|----------|---------|---------|---------|
| 1        | 107     | 128     | 113     |
| 2        | 108     | 130     | 114     |
| 3        | 125     | 139     | 132     |
| 4        | 104     | 104     | 100     |
| 5        | 131     | 130     | 125     |
| 6        | 173     | 172     | 165     |
| 7        | 86      | 93      | 89      |
| 8        | 97      | 104     | 101     |
| 9        | 112     | 120     | 116     |
| 10       | 125     | 124     | 123     |
| 11       | 133     | 134     | 133     |
| 12       | 170     | 171     | 170     |
| 13       | 122     | 122     | 118     |
| 14       | 135     | 135     | 130     |
| 15       | 128     | 129     | 123     |
| 16       | 128     | 131     | 127     |
| 17       | 133     | 136     | 132     |
| 18       | 133     | 136     | 132     |



TABLE 11

## Experience Ratings Using Judgment

| Film No. | Group 1 | Group 2 | Group 3 | Group 4 |
|----------|---------|---------|---------|---------|
| 1        | 102     | 105     | 104     | 101     |
| 2        | 104     | 107     | 106     | 105     |
| 3        | 120     | 125     | 122     | 119     |
| 4        | 86      | 89      | 87      | 84      |
| 5        | 108     | 112     | 109     | 106     |
| 6        | 142     | 146     | 145     | 139     |
| 7        | 85      | 91      | 90      | 88      |
| 8        | 95      | 102     | 101     | 99      |
| 9        | 110     | 117     | 116     | 114     |
| 10       | 101     | 105     | 104     | 102     |
| 11       | 109     | 115     | 112     | 110     |
| 12       | 140     | 145     | 144     | 140     |
| 13       | 106     | 109     | 107     | 107     |
| 14       | 117     | 121     | 118     | 119     |
| 15       | 111     | 115     | 112     | 113     |
| 16       | 106     | 107     | 107     | 106     |
| 17       | 114     | 115     | 116     | 114     |
| 18       | 114     | 115     | 116     | 114     |

TABLE 1. 1980-1981

| Year | 1980 | 1981 | 1982 | 1983 |
|------|------|------|------|------|
| 1    | 101  | 101  | 101  | 101  |
| 2    | 101  | 101  | 101  | 101  |
| 3    | 101  | 101  | 101  | 101  |
| 4    | 101  | 101  | 101  | 101  |
| 5    | 101  | 101  | 101  | 101  |
| 6    | 101  | 101  | 101  | 101  |
| 7    | 101  | 101  | 101  | 101  |
| 8    | 101  | 101  | 101  | 101  |
| 9    | 101  | 101  | 101  | 101  |
| 10   | 101  | 101  | 101  | 101  |
| 11   | 101  | 101  | 101  | 101  |
| 12   | 101  | 101  | 101  | 101  |
| 13   | 101  | 101  | 101  | 101  |
| 14   | 101  | 101  | 101  | 101  |
| 15   | 101  | 101  | 101  | 101  |
| 16   | 101  | 101  | 101  | 101  |
| 17   | 101  | 101  | 101  | 101  |
| 18   | 101  | 101  | 101  | 101  |

## TABLE 12

Experience Ratings Plus Allowances Using  
Single-Image Film

| Film No. | Group 1 | Group 2 | Group 3 | Group 4 |
|----------|---------|---------|---------|---------|
| 1        | 109     | 112     | 112     | 113     |
| 2        | 111     | 114     | 123     | 114     |
| 3        | 126     | 131     | 131     | 132     |
| 4        | 89      | 95      | 97      | 97      |
| 5        | 113     | 119     | 122     | 122     |
| 6        | 149     | 156     | 162     | 160     |
| 7        | 74      | 87      | 112     | 83      |
| 8        | 83      | 99      | 97      | 93      |
| 9        | 96      | 113     | 112     | 108     |
| 10       | 101     | 109     | 111     | 108     |
| 11       | 109     | 118     | 120     | 116     |
| 12       | 139     | 150     | 152     | 149     |
| 13       | 109     | 122     | 114     | 117     |
| 14       | 120     | 123     | 128     | 129     |
| 15       | 114     | 117     | 121     | 123     |
| 16       | 106     | 120     | 117     | 123     |
| 17       | 109     | 123     | 121     | 127     |
| 18       | 109     | 123     | 121     | 127     |





Table 13  
Experience Ratings plus Allowances  
Using Multi-Image Film

| Film No. | Group 1 | Group 2 | Group 3 |
|----------|---------|---------|---------|
| 1        | 115     | 115     | 116     |
| 2        | 116     | 115     | 119     |
| 3        | 135     | 135     | 137     |
| 4        | 105     | 102     | 102     |
| 5        | 125     | 130     | 129     |
| 6        | 170     | 171     | 170     |
| 7        | 90      | 94      | 92      |
| 8        | 101     | 105     | 105     |
| 9        | 115     | 121     | 116     |
| 10       | 125     | 127     | 122     |
| 11       | 152     | 157     | 151     |
| 12       | 169     | 179     | 168     |
| 13       | 125     | 119     | 121     |
| 14       | 156     | 151     | 155     |
| 15       | 129     | 124     | 127     |
| 16       | 151     | 150     | 150     |
| 17       | 157     | 154     | 154     |
| 18       | 157     | 154     | 154     |



TABLE 14

## Concept of Standard Ratings Using Judgment

| File No. | Group 1 | Group 2 |
|----------|---------|---------|
| 1        | 103     | 102     |
| 2        | 105     | 104     |
| 3        | 122     | 120     |
| 4        | 86      | 87      |
| 5        | 108     | 110     |
| 6        | 143     | 144     |
| 7        | 89      | 89      |
| 8        | 100     | 100     |
| 9        | 115     | 115     |
| 10       | 103     | 103     |
| 11       | 112     | 111     |
| 12       | 143     | 142     |
| 13       | 108     | 107     |
| 14       | 119     | 118     |
| 15       | 113     | 112     |
| 16       | 107     | 106     |
| 17       | 113     | 114     |
| 18       | 113     | 114     |

STANDARD GRADE 1 READING TEST

STORY 1

STORY 2

STORY 3

101

101

1

102

102

2

103

103

3

104

104

4

105

105

5

106

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18

TABLE 15  
 Concept of Standard Ratings Plus  
 Allowances Using Single-Image Film

| Film No. | Group 1 | Group 2 |
|----------|---------|---------|
| 1        | 112     | 112     |
| 2        | 114     | 114     |
| 3        | 131     | 132     |
| 4        | 97      | 97      |
| 5        | 121     | 122     |
| 6        | 160     | 160     |
| 7        | 86      | 82      |
| 8        | 96      | 92      |
| 9        | 111     | 103     |
| 10       | 106     | 113     |
| 11       | 115     | 124     |
| 12       | 148     | 139     |
| 13       | 116     | 113     |
| 14       | 128     | 125     |
| 15       | 121     | 119     |
| 16       | 121     | 119     |
| 17       | 125     | 124     |
| 18       | 125     | 124     |

1911 1912 1913 1914 1915 1916 1917 1918 1919 1920

1921 1922 1923 1924 1925 1926 1927 1928 1929 1930

1931 1932 1933 1934 1935 1936 1937 1938 1939 1940

1941 1942 1943 1944 1945 1946 1947 1948 1949 1950

1951 1952 1953 1954 1955 1956 1957 1958 1959 1960

1961 1962 1963 1964 1965 1966 1967 1968 1969 1970

1971 1972 1973 1974 1975 1976 1977 1978 1979 1980

1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

1991 1992 1993 1994 1995 1996 1997 1998 1999 2000

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

2031 2032 2033 2034 2035 2036 2037 2038 2039 2040

2041 2042 2043 2044 2045 2046 2047 2048 2049 2050

2051 2052 2053 2054 2055 2056 2057 2058 2059 2060

2061 2062 2063 2064 2065 2066 2067 2068 2069 2070

2071 2072 2073 2074 2075 2076 2077 2078 2079 2080

2081 2082 2083 2084 2085 2086 2087 2088 2089 2090

2091 2092 2093 2094 2095 2096 2097 2098 2099 2100

2101 2102 2103 2104 2105 2106 2107 2108 2109 2110

2111 2112 2113 2114 2115 2116 2117 2118 2119 2120

2121 2122 2123 2124 2125 2126 2127 2128 2129 2130

2131 2132 2133 2134 2135 2136 2137 2138 2139 2140

2141 2142 2143 2144 2145 2146 2147 2148 2149 2150

2151 2152 2153 2154 2155 2156 2157 2158 2159 2160

2161 2162 2163 2164 2165 2166 2167 2168 2169 2170

2171 2172 2173 2174 2175 2176 2177 2178 2179 2180

2181 2182 2183 2184 2185 2186 2187 2188 2189 2190

2191 2192 2193 2194 2195 2196 2197 2198 2199 2200

2201 2202 2203 2204 2205 2206 2207 2208 2209 2210

2211 2212 2213 2214 2215 2216 2217 2218 2219 2220

2221 2222 2223 2224 2225 2226 2227 2228 2229 2230

2231 2232 2233 2234 2235 2236 2237 2238 2239 2240

2241 2242 2243 2244 2245 2246 2247 2248 2249 2250

2251 2252 2253 2254 2255 2256 2257 2258 2259 2260

2261 2262 2263 2264 2265 2266 2267 2268 2269 2270

2271 2272 2273 2274 2275 2276 2277 2278 2279 2280

2281 2282 2283 2284 2285 2286 2287 2288 2289 2290

2291 2292 2293 2294 2295 2296 2297 2298 2299 2300

2301 2302 2303 2304 2305 2306 2307 2308 2309 2310

2311 2312 2313 2314 2315 2316 2317 2318 2319 2320

2321 2322 2323 2324 2325 2326 2327 2328 2329 2330

2331 2332 2333 2334 2335 2336 2337 2338 2339 2340

2341 2342 2343 2344 2345 2346 2347 2348 2349 2350

2351 2352 2353 2354 2355 2356 2357 2358 2359 2360

2361 2362 2363 2364 2365 2366 2367 2368 2369 2370

2371 2372 2373 2374 2375 2376 2377 2378 2379 2380

2381 2382 2383 2384 2385 2386 2387 2388 2389 2390

2391 2392 2393 2394 2395 2396 2397 2398 2399 2400

2401 2402 2403 2404 2405 2406 2407 2408 2409 2410

2411 2412 2413 2414 2415 2416 2417 2418 2419 2420

2421 2422 2423 2424 2425 2426 2427 2428 2429 2430

2431 2432 2433 2434 2435 2436 2437 2438 2439 2440

2441 2442 2443 2444 2445 2446 2447 2448 2449 2450

2451 2452 2453 2454 2455 2456 2457 2458 2459 2460

2461 2462 2463 2464 2465 2466 2467 2468 2469 2470

2471 2472 2473 2474 2475 2476 2477 2478 2479 2480

2481 2482 2483 2484 2485 2486 2487 2488 2489 2490

2491 2492 2493 2494 2495 2496 2497 2498 2499 2500

TABLE 16

Concept of Standard Ratings Plus  
Allowances Using Multi-Image Film

| Film No. | Group 1 | Group 2 |
|----------|---------|---------|
| 1        | 114     | 116     |
| 2        | 116     | 117     |
| 3        | 135     | 136     |
| 4        | 103     | 93      |
| 5        | 129     | 128     |
| 6        | 171     | 168     |
| 7        | 91      | 94      |
| 8        | 102     | 105     |
| 9        | 116     | 121     |
| 10       | 122     | 125     |
| 11       | 132     | 136     |
| 12       | 169     | 172     |
| 13       | 120     | 121     |
| 14       | 133     | 134     |
| 15       | 127     | 128     |
| 16       | 120     | 129     |
| 17       | 134     | 134     |
| 18       | 134     | 134     |

Table 1. Summary of the results of the  
analysis of variance for the different factors.

| Source | Sum of Squares | Mean Square | F    | Prob > F |
|--------|----------------|-------------|------|----------|
| 1      | 1.00           | 1.00        | 1.00 | .97      |
| 2      | 1.00           | 1.00        | 1.00 | .97      |
| 3      | 1.00           | 1.00        | 1.00 | .97      |
| 4      | 1.00           | 1.00        | 1.00 | .97      |
| 5      | 1.00           | 1.00        | 1.00 | .97      |
| 6      | 1.00           | 1.00        | 1.00 | .97      |
| 7      | 1.00           | 1.00        | 1.00 | .97      |
| 8      | 1.00           | 1.00        | 1.00 | .97      |
| 9      | 1.00           | 1.00        | 1.00 | .97      |
| 10     | 1.00           | 1.00        | 1.00 | .97      |
| 11     | 1.00           | 1.00        | 1.00 | .97      |
| 12     | 1.00           | 1.00        | 1.00 | .97      |
| 13     | 1.00           | 1.00        | 1.00 | .97      |
| 14     | 1.00           | 1.00        | 1.00 | .97      |
| 15     | 1.00           | 1.00        | 1.00 | .97      |
| 16     | 1.00           | 1.00        | 1.00 | .97      |



TABLE 17

Size of Town Ratings Plus Allowances

Using Single-Image Film

| Film No. | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 |
|----------|---------|---------|---------|---------|---------|---------|
| 1        | 119     | 111     | 112     | 114     | 110     | 117     |
| 2        | 121     | 113     | 114     | 116     | 112     | 119     |
| 3        | 139     | 130     | 132     | 135     | 130     | 138     |
| 4        | 105     | 97      | 99      | 103     | 106     | 106     |
| 5        | 131     | 122     | 124     | 128     | 133     | 133     |
| 6        | 174     | 161     | 164     | 169     | 176     | 175     |
| 7        | 95      | 92      | 88      | 87      | 87      | 98      |
| 8        | 106     | 103     | 99      | 99      | 98      | 110     |
| 9        | 123     | 135     | 114     | 113     | 112     | 126     |
| 10       | 120     | 119     | 120     | 121     | 128     | 133     |
| 11       | 130     | 128     | 130     | 131     | 138     | 143     |
| 12       | 166     | 165     | 166     | 167     | 177     | 184     |
| 13       | 121     | 124     | 116     | 117     | 119     | 130     |
| 14       | 134     | 137     | 129     | 130     | 131     | 143     |
| 15       | 128     | 130     | 122     | 123     | 124     | 136     |
| 16       | 132     | 130     | 122     | 128     | 137     | 132     |
| 17       | 137     | 134     | 127     | 133     | 143     | 137     |
| 18       | 137     | 134     | 127     | 133     | 143     | 137     |

TABLE 1. - SUMMARY OF DATA FOR THE 1950-1951 SEASON

UNITED STATES DEPARTMENT OF AGRICULTURE

| Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
|---------|---------|---------|---------|---------|---------|---------|
| 1       | 111     | 111     | 111     | 111     | 111     | 111     |
| 2       | 112     | 112     | 112     | 112     | 112     | 112     |
| 3       | 113     | 113     | 113     | 113     | 113     | 113     |
| 4       | 114     | 114     | 114     | 114     | 114     | 114     |
| 5       | 115     | 115     | 115     | 115     | 115     | 115     |
| 6       | 116     | 116     | 116     | 116     | 116     | 116     |
| 7       | 117     | 117     | 117     | 117     | 117     | 117     |
| 8       | 118     | 118     | 118     | 118     | 118     | 118     |
| 9       | 119     | 119     | 119     | 119     | 119     | 119     |
| 10      | 120     | 120     | 120     | 120     | 120     | 120     |
| 11      | 121     | 121     | 121     | 121     | 121     | 121     |
| 12      | 122     | 122     | 122     | 122     | 122     | 122     |
| 13      | 123     | 123     | 123     | 123     | 123     | 123     |
| 14      | 124     | 124     | 124     | 124     | 124     | 124     |
| 15      | 125     | 125     | 125     | 125     | 125     | 125     |
| 16      | 126     | 126     | 126     | 126     | 126     | 126     |
| 17      | 127     | 127     | 127     | 127     | 127     | 127     |
| 18      | 128     | 128     | 128     | 128     | 128     | 128     |

TABLE 18

Size of Town Ratings Plus Allowances

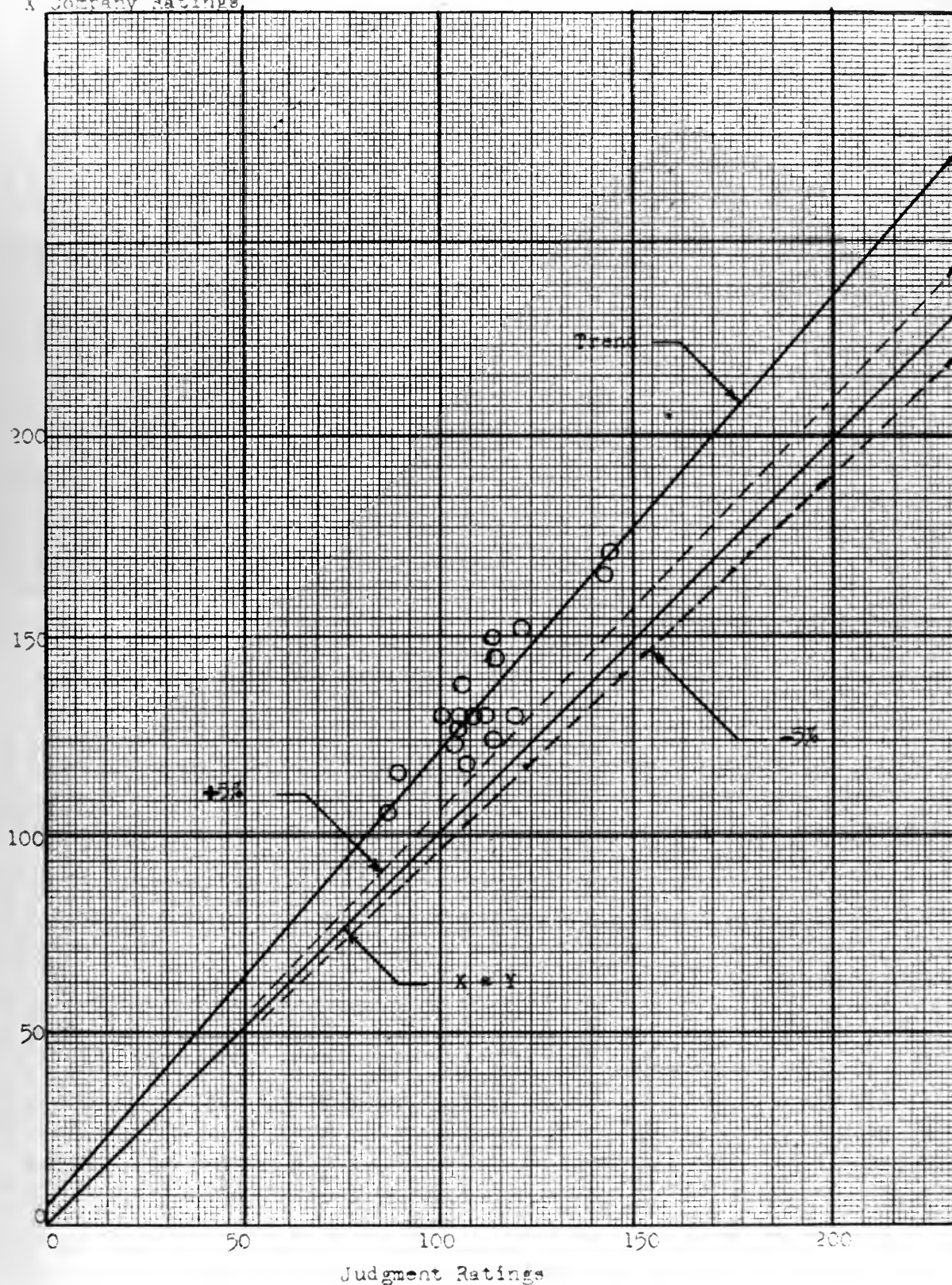
Using Multi-Image Film

| Film No. | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 |
|----------|---------|---------|---------|---------|---------|---------|
| 1        | 103     | 105     | 103     | 104     | 112     | 98      |
| 2        | 105     | 107     | 104     | 105     | 113     | 100     |
| 3        | 121     | 124     | 121     | 122     | 131     | 115     |
| 4        | 85      | 91      | 85      | 87      | 95      | 84      |
| 5        | 107     | 114     | 107     | 109     | 119     | 105     |
| 6        | 141     | 150     | 140     | 144     | 157     | 138     |
| 7        | 88      | 91      | 91      | 88      | 91      | 89      |
| 8        | 98      | 102     | 102     | 99      | 102     | 100     |
| 9        | 113     | 117     | 117     | 114     | 117     | 115     |
| 10       | 103     | 107     | 100     | 104     | 109     | 103     |
| 11       | 111     | 115     | 108     | 112     | 117     | 111     |
| 12       | 142     | 147     | 138     | 144     | 150     | 142     |
| 13       | 107     | 116     | 109     | 108     | 113     | 102     |
| 14       | 119     | 128     | 119     | 119     | 125     | 112     |
| 15       | 113     | 122     | 113     | 113     | 119     | 107     |
| 16       | 106     | 112     | 107     | 106     | 114     | 101     |
| 17       | 114     | 121     | 115     | 114     | 122     | 109     |
| 18       | 114     | 121     | 115     | 114     | 122     | 109     |

| 1917 | 1916 | 1915 | 1914 | 1913 | 1912 | 1911 |
|------|------|------|------|------|------|------|
| 1    | 102  | 102  | 102  | 102  | 102  | 102  |
| 2    | 102  | 102  | 102  | 102  | 102  | 102  |
| 3    | 102  | 102  | 102  | 102  | 102  | 102  |
| 4    | 102  | 102  | 102  | 102  | 102  | 102  |
| 5    | 102  | 102  | 102  | 102  | 102  | 102  |
| 6    | 102  | 102  | 102  | 102  | 102  | 102  |
| 7    | 102  | 102  | 102  | 102  | 102  | 102  |
| 8    | 102  | 102  | 102  | 102  | 102  | 102  |
| 9    | 102  | 102  | 102  | 102  | 102  | 102  |
| 10   | 102  | 102  | 102  | 102  | 102  | 102  |
| 11   | 102  | 102  | 102  | 102  | 102  | 102  |
| 12   | 102  | 102  | 102  | 102  | 102  | 102  |
| 13   | 102  | 102  | 102  | 102  | 102  | 102  |
| 14   | 102  | 102  | 102  | 102  | 102  | 102  |
| 15   | 102  | 102  | 102  | 102  | 102  | 102  |
| 16   | 102  | 102  | 102  | 102  | 102  | 102  |
| 17   | 102  | 102  | 102  | 102  | 102  | 102  |
| 18   | 102  | 102  | 102  | 102  | 102  | 102  |
| 19   | 102  | 102  | 102  | 102  | 102  | 102  |
| 20   | 102  | 102  | 102  | 102  | 102  | 102  |
| 21   | 102  | 102  | 102  | 102  | 102  | 102  |
| 22   | 102  | 102  | 102  | 102  | 102  | 102  |
| 23   | 102  | 102  | 102  | 102  | 102  | 102  |
| 24   | 102  | 102  | 102  | 102  | 102  | 102  |
| 25   | 102  | 102  | 102  | 102  | 102  | 102  |
| 26   | 102  | 102  | 102  | 102  | 102  | 102  |
| 27   | 102  | 102  | 102  | 102  | 102  | 102  |
| 28   | 102  | 102  | 102  | 102  | 102  | 102  |
| 29   | 102  | 102  | 102  | 102  | 102  | 102  |
| 30   | 102  | 102  | 102  | 102  | 102  | 102  |
| 31   | 102  | 102  | 102  | 102  | 102  | 102  |

Figure 1

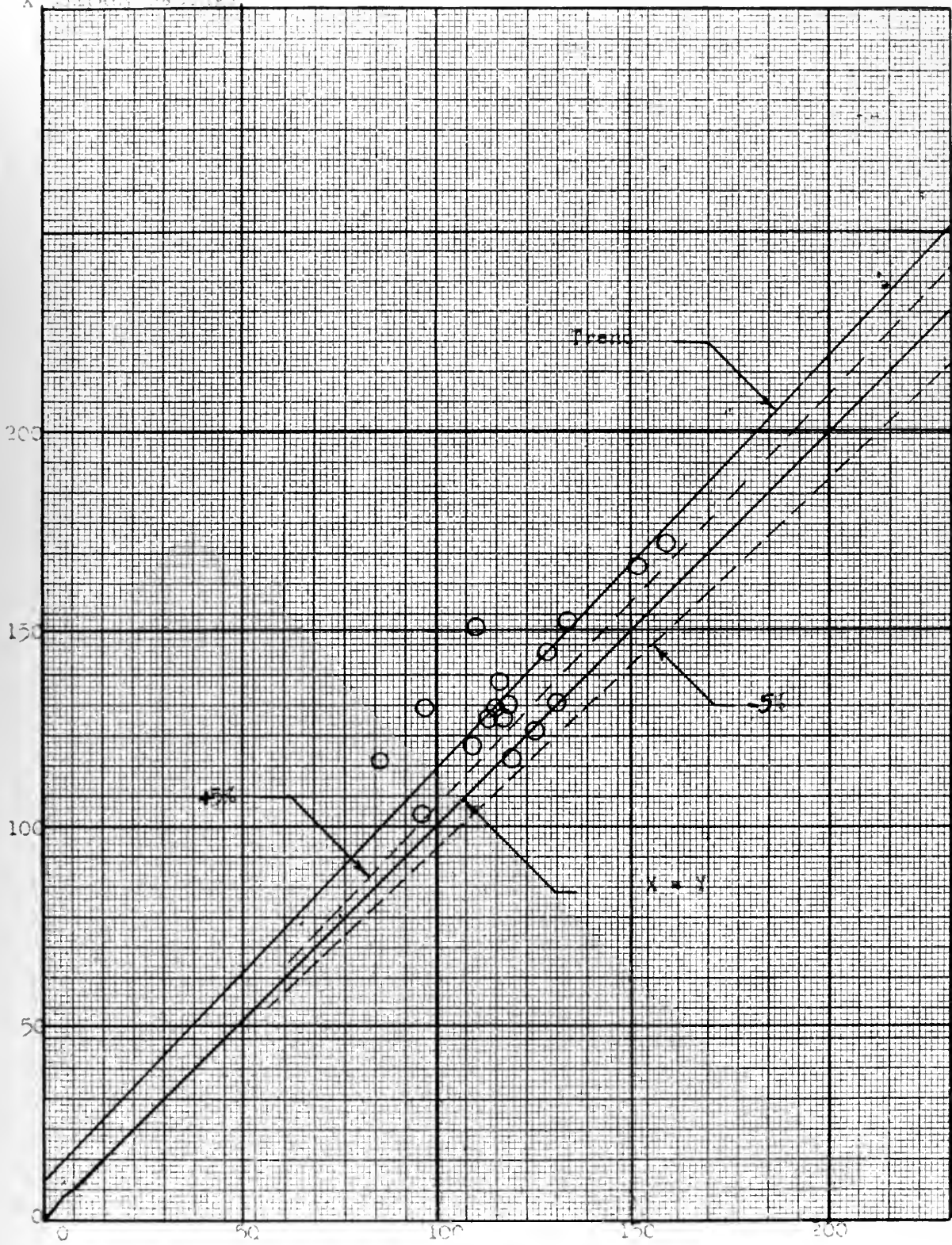
X Company Ratings



Judgment Ratings Versus X Company Ratings



X Company Ratings



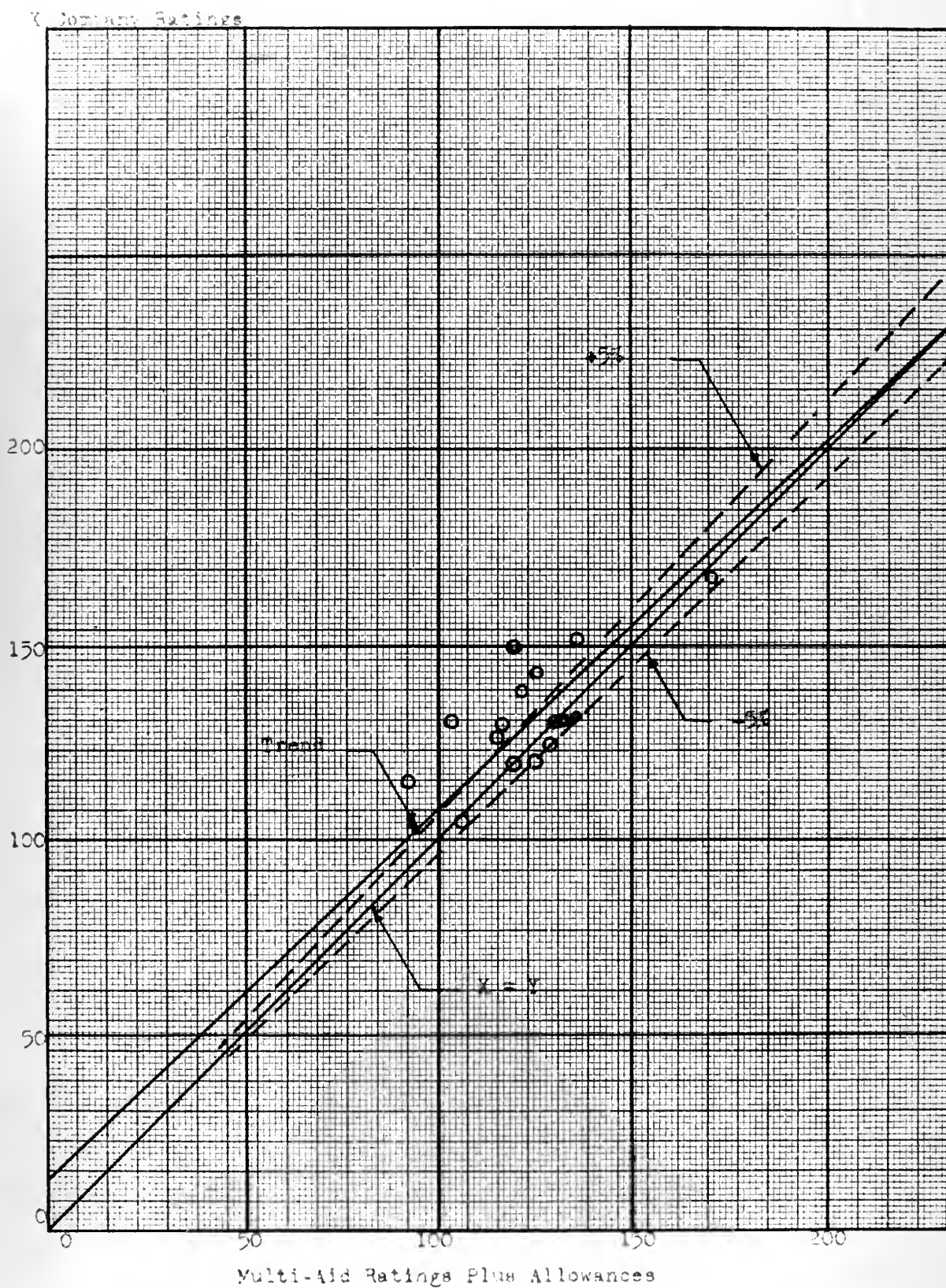
Single Aid Ratings Plus Allowances

Single Aid Ratings Plus Allowances Versus X Company Ratings





Figure 3



Multi-Aid Ratings Plus Allowances Versus X Company Ratings



FIGURE 4  
TIME STUDY WORK SESSION QUESTIONNAIRE

BSB-TSQ 11-FD

BE SURE TO COPY THE FIRST THREE DIGITS OF YOUR CARD DECK NUMBER IN THE SPACE PROVIDED. Please answer all questions as accurately as possible. Circle number to left of appropriate answer. All of the information on this questionnaire is considered CONFIDENTIAL. Neither your name nor the company name will be revealed in any way.

|    |    |    |
|----|----|----|
|    |    |    |
| 1. | 2. | 3. |

A. Name \_\_\_\_\_

B. Company \_\_\_\_\_

4. Mailing Address \_\_\_\_\_

5. What characterizes the direct labor in your plant:

1. Bench work
2. Machine work
3. Gross body movements (moving around)
4. Equal amounts of all three named above.

6. Number of employees in your plant.

1. 50 or less
2. 51 to 100
3. 101 to 200
4. 201 to 300
5. 301 to 500
6. 501 to 750
7. 751 to 1000
8. 1001 to 1500
9. Over 1500

7. Length of time you have been making time studies.

1. Less than six months and actively engaged
2. Less than six months, but not now actively engaged
3. More than six months, but less than a year and actively engaged
4. More than six months, but less than a year and not now actively engaged
5. More than one year, but less than two years and actively engaged
6. More than one year, but less than two years and now now actively engaged
7. Two to four years
8. Five to ten years
9. Over ten years

8. Where did you receive your initial time study training? Give name and location.

1. College \_\_\_\_\_
2. Extension \_\_\_\_\_
3. Company \_\_\_\_\_
4. Other \_\_\_\_\_

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11. Do you rate compared to

1. your concept of standard performance
2. some film or other embodiment of standard performance

100

12. Do you rate

1. pace
2. rate of activity
3. speed of movement
4. skill and effort
5. effort
6. skill, effort, conditions, and consistency (Westinghouse)
7. effective speed
8. attitude plus other factors
9. Other \_\_\_\_\_

13. Which method do you use for your ratings?

1. a point basis
2. a percentage basis

14. Do you use wage incentives?

1. Yes
2. No

15. Do you apply an incentive allowance to final computed time study results?

1. Yes, how much \_\_\_\_\_
2. No.

17. What is the percent increment or ratio by which the typical employee can exceed the standard? \_\_\_\_\_

18. Please define the Standard performance which you use as a basis for your ratings in terms of "who", "doing what", and "Working how".

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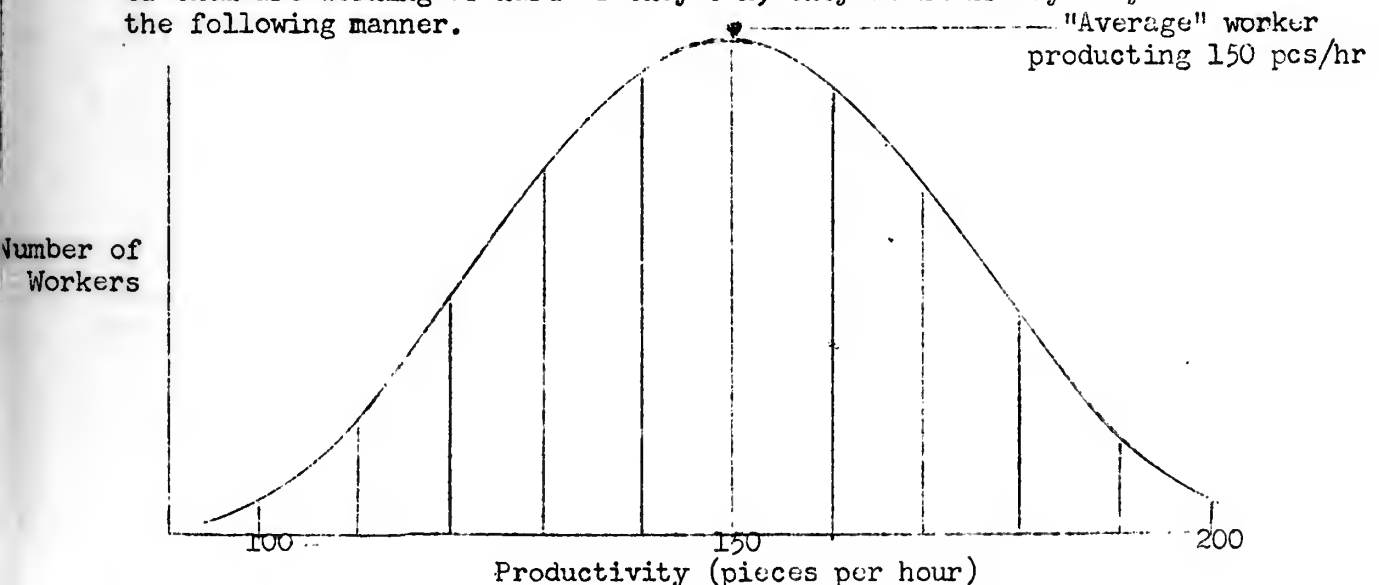


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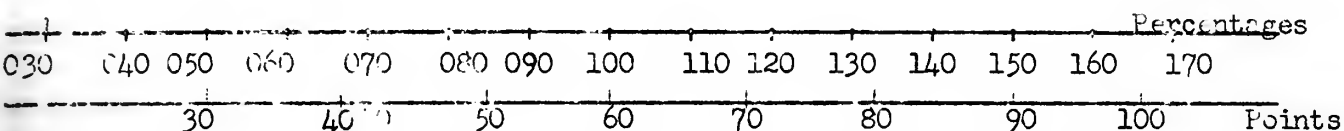
19. Assuming you have a large number of workers on one job, and that all of them are working as hard as they can, they would likely vary in the following manner.



(Question 19 continued on next page)



19. (Con't) Please indicate on the following scale the rating value you would assign if you observed the "average" worker working as hard as he could and producing 150 pieces per hour. Mark the appropriate scale at the appropriate place.



22. When studying a job, do you require a performance within a certain range?  
(Such as requiring a performance between 80% and 120% before the study is made).  
If so, please state limits.

Use one set of appropriate blanks.

\_\_\_\_\_ to \_\_\_\_\_ percentages  
\_\_\_\_\_ to \_\_\_\_\_ points

23. Do you have a union in your plant?

1. yes
2. no

24. Do you have union participation in your time studies?

1. yes
2. no

25. What is your position in the organization of the plant?

1. Head of Industrial Engineering Dept.
2. Member of staff of Indust. Eng. Dept.
3. Head of Time Study Dept.
4. Member of staff of Time study dept.
5. Head of Production Department
6. Member of Staff of Production Dept.
7. Head of Control Dept.
8. Member of staff of Control Dept.
9. Other \_\_\_\_\_

26. Do you have an engineering degree?

1. Yes
2. No

27. About how long has your plant been making time studies?

1. Less than a year
2. 1 to 3 years
3. 4 to 6 years
4. 7 to 10 years
5. Over 10 years
6. I don't know.

28. Which of the following methods of recording time studies do you make the most use of in your plant?

1. Continuous timing
2. Repetitive (snap-back) timing
3. Accumulative timing
4. Camera

29. About what percentage of the employees in your plant are union members?

\_\_\_\_\_ %.





30. If your union contract contains sections pertaining to time study work, which of the following may be found in your contract?
1. Definition of Standard
  2. Incentive Gap (earnings over standard)
  3. Time study grievance procedure
  4. Other \_\_\_\_\_  
\_\_\_\_\_
  5. I don't know.
31. If the head of a department, to whom do you report or to whom does your head report?
1. Vice president in charge of Manufacturing
  2. General Manager
  3. Comptroller
  4. Superintendent
  5. Plant Manager
  6. Other \_\_\_\_\_
32. If you are, or were to be, head of a department, to whom do you think you should report?
1. Vice President in charge of Manufacturing
  2. General Manager
  3. Comptroller
  4. Superintendent
  5. Plant Manager
  6. Other \_\_\_\_\_
33. Do you consider the position you hold carries with it enough authority to put into operation the plans and ideas you have?
1. Yes
  2. No
34. If you are not satisfied with the position you now hold, what position do you think would best suit your needs (with reference to better time studies)?  
\_\_\_\_\_  
\_\_\_\_\_
35. Were you hired directly into the time study department?
1. Yes
  2. No
36. If transferred to the time study department, what department were you in before the transfer occurred? \_\_\_\_\_
37. Are you satisfied with the salary you receive?
1. Yes
  2. No
38. What is the extent of your education?
1. Grammar School
  2. High School
  3. Trade School
  4. Business School
  5. College (list all degrees) \_\_\_\_\_  
\_\_\_\_\_



39. If a graduate engineer, do you hold an "Engineer-In Training" certificate?  
1. Yes  
2. No
40. If a graduate engineer, do you hold a Professional Engineer's License?  
1. Yes  
2. No
41. What is the minimum amount of education you believe necessary for time study work?  
1. Grammar School  
2. High School  
3. College
42. Do you consider a college education \_\_\_\_\_ for time study work?  
1. essential  
2. desirable  
3. unnecessary
43. If you are of the opinion that a college education is essential or desirable, how many years would you recommend? \_\_\_\_\_ years.
44. What type of college education do you consider best suited to time study work?  
1. Engineering  
2. Business  
3. Science  
4. Other \_\_\_\_\_
45. Do you consider shop experience \_\_\_\_\_ for time study work?  
1. Essential  
2. Desirable  
3. Unnecessary
46. If you consider shop experience to be essential or desirable, how much experience would you recommend? \_\_\_\_\_ years
47. Is there an Industrial Engineering Department in your plant?  
1. Yes  
2. No
48. Is there a separate Time Study Department in your plant?  
1. Yes  
2. No
49. Total number of men on staff actively engaged in time study work. \_\_\_\_\_ men
50. Number of engineers on staff actively engaged in time study work.  
\_\_\_\_\_ engineers
51. Number of union men on staff actively engaged in time study work. \_\_\_\_\_ men
52. Considering the number of employees in your plant, how many men do you believe should be on the time study staff? \_\_\_\_\_ men

1000

1000

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53. Do you believe that you have the cooperation of top management in doing your work?
1. Yes
  2. No
54. Do you believe your time study department to be sufficiently staffed with competent and well qualified personnel to do the job expected of it?
1. Yes
  2. No
55. Do the employees in your plant have a good understanding of time study principles?
1. Yes
  2. No
56. Is the educational program in your plant to give employees a better understanding of time study
1. adequate?
  2. inadequate?
  3. no program in effect.
57. Are the educational programs in your plant dealing with time study for the employees given on
1. company time?
  2. employees' time?
  3. a combination of both?
  4. none given
58. In general, are the employees in favor of time study?
1. Yes
  2. No
59. Do the employees cooperate with the time study staff?
1. Yes
  2. No
60. Do you believe that the foremen and supervisors in your plant are adequately educated in a proper understanding of modern time study practices?
1. Yes
  2. No
61. The educational program for foremen and supervisors on time study practices in your company is
1. adequate
  2. inadequate
  3. no program in effect.
62. Are the educational programs dealing with time study for foremen and supervisors given on
1. company time?
  2. employees' time?
  3. a combination of both?
63. Do you believe that a company should have a training program for its time study personnel?
1. Yes
  2. No



64. Does your company have a training program for its time study personnel that is
1. adequate
  2. inadequate
  3. no program in effect.
65. Are the training programs for time study men given on
1. company time?
  2. employees' time?
  3. a combination of both?
  4. none given
66. Is the training program for the union time study men the same as that for the company's men?
1. Yes
  2. No
  3. none for union men
67. If the answer to question (66) is no, is the training program for the union men
1. adequate?
  2. inadequate?
68. Is the training program for the union time study men given by
1. the union only?
  2. the company only?
  3. both the union and the company?
  4. an outside agency?
  5. none given
69. Does your company have any specific injunction against the use of motion pictures for methods study?
1. Yes
  2. No
70. Does your company have any specific injunction against the use of motion pictures for time study?
1. Yes
  2. No





FIGURE 5  
CALIBRATION CHART

Bench mark value for each image of the Multi-Image rating loop

Images and their corresponding bench mark value are arranged in the Multi-Image loop as follows:

| IMAGE NO. | BENCH MARK VALUE. |       |
|-----------|-------------------|-------|
| 1         | 2                 | 3     |
| 155.8     | 143.8             | 137.6 |
| 4         | 5                 | 6     |
| 132.4     | 122.8             | 118.5 |
| 7         | 8                 | 9     |
| 105.3     | 98.7              | 95.3  |
| 10        | 11                | 12    |
| 93.0      | 81.6              | 79.2  |

*Journal of Management Education* 30(6)

1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

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